GENERAL LIBRARY,
UNIV. OF MICH.
MAR 22 1899

BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

Vol. X.—Nos. 94-95-96.] BALTIMORE, JANUARY-FEBRUARY-MARCH, 1899. [Price, 40 Cents.

CONTENTS.

PAGE.

The Dissection and Liberation of the Sphincter Ani Muscle followed by its Direct Suture in Cases of Complete Tear of the Perineum, with a Splinting Suture passing between the Outer and Inner Margins of the Muscle. By H. A. Kelly, M. D., - 1

Aberrant Portions of the Müllerian Duct found in an Ovary. By Wm. Wood Russell, M. D., - - - - - - - - - - - 8

The Cause and Significance of Uterine Hemorrhage in Cases of Myoma Uteri. By J. G. Clark, M. D., - - - - - - - - - 11

A Study of Sixty-seven Cases of Primary Malignant Tumors of the Suprarenal Gland. By Otto Ramsay, M. D., - - - - - 20

The Bacteriology of the Cavity of the Corpus Uteri of the Non-pregnant Woman. A Report of 68 Cases. By G. Brown Miller, M. D., - - - - - - - - - - - - - - - - - - - 29

PAGE.

The Presence of Foreign Bodies in the Vermiform Appendix, with Especial Reference to Pointed Bodies. By James F. Mitchell, M. D., - - - - - - - - - - - - - - - - - - - 35

Origin, Development and Degeneration of the Blood-vessels of the Ovary. By J. G. Clark, M. D., - - - - - - - - - - - 40

Ovarian Cysts in the Negress. By Thomas R. Brown, M. D., - 44

On a Hitherto Undescribed Peptonising Diplococcus causing Acute Ulcerative Endocarditis. By W. G. MacCallum, M. D., and T. W. Hastings, M. D., - - - - - - - - - - - 46

Alfredo Antunes Kantback, - - - - - - - - - - - - - - - 47

Notes on New Books, - - - - - - - - - - - - - - - - - 49

Books Received, - - - - - - - - - - - - - - - - - - - 50

THE DISSECTION AND LIBERATION OF THE SPHINCTER ANI MUSCLE FOLLOWED BY ITS DIRECT SUTURE IN CASES OF COMPLETE TEAR OF THE PERINEUM, WITH A SPLINTING SUTURE PASSING BETWEEN THE OUTER AND INNER MARGINS OF THE MUSCLE.

By H. A. Kelly, M. D., *Gynecologist-in-Chief, The Johns Hopkins Hospital.*

Although great progress has been made in gynecological plastic surgery within the past twenty years, there have been few or no changes in the treatment of complete perineal tears, that is, those which extend through the external sphincter ani.

The common symptom of a complete tear of the perineum is the lack of a control over the functions of the bowel, characterized by the involuntary escape of feces and gases. These sequelæ, however, are not invariably present in the same degree in all cases, and there is a diversity among them varying all the way from the entire loss of function on the one hand to perfect control on the other.

Some surgeons, reasoning upon supposedly physiological grounds, have gone so far as to assert that it is impossible for a woman with a divided sphincter to exercise any control whatever over the bowel function; I know, however, from repeated clinical evidences that perfect function may sometimes persist; it becomes therefore necessary to discover some satisfactory explanation of the facts rather than to deny them.

I would divide the cases of complete tear, to be investigated from this standpoint, into two groups. First, those in which the tear barely extends through the sphincter and goes no further, and, second, those in which the sphincter ends are separated by a well-defined interval of a centimeter or more.

In the first of these groups, where the muscle is only just divided and the ends lie close together, the cicatrization which follows the injury is a conservative effort on the part of nature, and soon results in the approximation of the ends of the muscle, knitting them firmly together, with only a plug of scar tissue between. In this event the muscle is no longer, in a true sense, a sphincter, as it cannot contract from all directions towards a central point, but is compelled henceforth, by the break on one side and the interposition of a plug of unyielding connective tissue, to contract up to the scar as a more or less fixed point, and this it does with greater or less efficiency. This peculiar effect produced upon the sphincter

by the interpolation of a mass of scar tissue was pointed out many years ago by Hildebrandt.

The second group relates to those cases in which the sphincter ends are not bound together; I have at present under my care a patient with a complete rupture of the perineum, with deep, perfectly marked sphincter pits, separated by the entire breadth of the anal orifice, with a relaxed everted vaginal outlet and a uterus in descensus and retroflexion, and yet she has absolute control over fecal movements, whether formed or liquid, and is never disturbed by involuntary escape of gases. What is the explanation of this fact?

A careful physical examination shows that the patient has perfect voluntary control over the internal sphincter muscle, extending from the external sphincter about 2 cm. upwards.

The tonic contraction of the internal sphincter and its response to a voluntary effort can be most readily tested *in propriâ personâ*. If the tip of the finger is well oiled while sitting in a warm bath and inserted about an inch into the bowel while slightly bearing down to relax the sphincter, then, upon causing a voluntary contraction, a prompt response on the part of the internal sphincter will be noticed. When not voluntarily relaxed, the internal sphincter is in a state of tonic contraction guarding the orifice, while the external sphincter is not always contracted.

I believe, therefore, from repeated clinical observations that the tonic control exercised over the bowel functions resides rather in the internal sphincter ani than in the external, and that the external sphincter muscle is a provision against an emergency and is intended to form a temporary, powerful supplement to the internal sphincter.

The external sphincter is of further use in the act of defecation, in breaking the fecal column at intervals, so tending to prevent prolapsus recti by creating a pause in the act and allowing time for more material to pass down into the rectum before the renewal of the straining.

This physiological fact explains the reason why, when the external sphincter ends lie close together and the internal sphincter is therefore uninjured, continence is always preserved.

I would add, too, to this category of manifest sphincter injuries, a much larger group of cases in which, owing to the fact that control over the bowels is retained, as well as owing to the natural, uninjured appearance of the anus, suspicion is disarmed, and the surgeon, even when he is brought into such close contact as is involved in the performance of a perineal operation, fails to recognize the fact that the sphincter ends are divided. I cannot sufficiently emphasize the importance of this observation, and therefore reiterate my conviction that many women have torn sphincters which are never discovered.

When the ends of the external sphincter muscle are separated by any considerable interval in a recent tear, then the internal sphincter is also torn, and, the wider the separation of the external sphincter ends, the greater the tear into the bowel and therefore of the internal sphincter above. What is true of the recent injury is true *a fortiori* several months later, when a wide tear is drawn down to a narrow line and an interval of 1 cm. between the pits may represent a rupture 3 cm. in depth. It is therefore to this tear of the internal sphincter that the loss of control over the bowel functions is due.

Operation.—The prevailing operation in this country is the Emmet, which I need not describe in detail as it is so well known. The operations practiced in Europe for the most part are of a similar nature, or flap-splitting or Hegar's method. The important principle in the Emmet procedure consists in the application of a series of sutures, to an area thoroughly denuded, first closing the bowel, then radiating out from the bowel, over the skin and onto the vaginal surfaces. Emmet further lays great stress upon a tension suture entering and emerging at points outside of and well behind the external sphincter ends and traversing the septum, for the purpose of supporting and keeping all the fibres of the sphincter ends together. Dr. Emmet told me on one occasion that the devising of this suture cost him more thought than almost anything he had done in gynecology.

Although this operation, as well as the others mentioned, when well carried out, succeeds admirably in many instances, it still leaves much to be desired in that there does remain a residuum of failures, and a considerably larger percentage of cases in which the function is so imperfect at first that we are obliged to wait weeks or months for the patient to gain a satisfactory control, and sometimes in this latter group there are women who will tell you that when their bowels become loose they always find their clothes more or less soiled, while they are also apt to be uncertain about the control of gases.

In order to meet the various objections to the operation as practiced at present, I have devised several procedures based upon the physiological principles dwelt upon above; the first important point is the dissection and liberation of both ends of the sphincter muscle, after which they are sutured together with buried cat-gut sutures, end against end.

I can perhaps best emphasize the importance I wish to give this step by citing the first case in which I was led to operate in such a way.

Case I.—The patient was brought to me in Dec., 1897, by Dr. J. A. Sexton, of Raleigh, N. C. She had had six previous operations performed for complete tear of the recto-vaginal septum, and upon inspecting the parts I found perfect union throughout, a pathologically small well-closed anus, and a far better result in the external appearance than is often secured in cases which are deemed successful. In spite of appearances, however, she had no control over the function of the bowel, and the gases escaped audibly at all times, and formed movements were discharged at once without the slightest ability on her part to restrain them (Fig. 1).

I was disinclined from my examination to do anything further to this patient, after all she had passed through, doubting whether I could improve her condition, but through Dr. Sexton's kind insistence I felt at last forced to make at least an earnest effort to better her state. So I operated Dec. 8, 1897, determined to make a clean dissection of the external sphincter, even, if necessary, going so far as to lay the entire muscle bare, so as to make sure of bringing its ends into apposition, and leaving the end of the bowel encircled by a good muscular ring, if one could be found in the neighborhood.

I began the operation by making a semilunar incision with its convexity directed towards the symphysis, half way round the anal orifice and about 1 cm. from the anal margin (Fig. 1). As the dissection through the scar tissue was carried into the perineum, the edges of the incision were drawn in opposite directions, exposing a wide crescentic area. I found now that the sphincter could be beauti-

fully demonstrated anatomically, and that the right end lay nearly in the normal position, but fixed in the median scar, while the left end lay at least 2½ cm. distant from the right end, and was attached to the tuberosity of the ischium (Fig. 2). After laying bare and freeing 2 cm. of each of the ends, I then trimmed off the scar tissue so as to expose fresh red muscular bundles, which I then united with three interrupted buried cat-gut sutures, simply transfixing the sphincter muscle 5 or 6 mm. from the cut ends. Two buried sutures were also used in the septum in the deeper fat layer of the wound, and the skin wound was finally closed with fine silk sutures (Fig. 3). The result was a perfect union and greatly improved control of the bowel from the first. I examined the patient again two months later, and passing a finger a short distance into the rectum and grasping the sphincter between finger tip and thumb could distinctly isolate it on all sides, and on telling her to contract the muscle I could feel that it was perfect throughout and under complete control.

I do not know of any other instance in which with an apparently well-formed anal orifice the sphincter muscle has been laid bare and the separated ends freed from their attachments and then joined by buried sutures.

Following the initiative of this case, I at once incorporated the dissection, isolation and separate suture of the sphincter muscle as an essential part of the technique of all my operations for complete tears, intending in this way to insure the bringing of the sphincter into the field as well as the exact union of its parts, end to end.

CASE II.—The next case was one of the classical sort, a secondary operation for complete tear where the parts had well cicatrized.

She was operated upon towards the end of February, 1898. She had had a complete tear of the perineum in consequence of a forceps labor conducted by myself in the preceding December; the immediate suture failed, and since that time she had had no control whatever over the bowel function. In place of the perineum there was a boat-shaped cicatrix extending from two lateral prominences marking the former position of the fourchette, extending back to the anus. The recently cicatrized tissue fairly marked out the extent of the original tear in somewhat diminished form. I proceeded by denuding the vaginal sulci and the lateral surfaces as usual. I then exposed the sphincter ends by turning down a triangular flap of uninjured skin lying in front of the anus (see Fig. 4), catching the ends in their pits one at a time, pulling them up and out a little, and snipping with blunt-pointed scissors on all sides of the eminence until each sphincter muscle stood dissected out with perfect distinctness about 2 cm. beyond the surrounding tissue. On lifting the ends up the pull on the posterior part of the sphincter could be distinctly felt with the thumb and forefinger grasping the margin of the anus. The exposed ends were then denuded of the film of scar tissue covering them and brought evenly together with interrupted cat-gut sutures; the flap which was turned down over the bowel during the dissection was then brought up over the sphincter, and the rest of the wound closed as usual. The result was a perfect control over the function of the bowel from the very first, leaving nothing to be desired in respect to function, and the patient has now, a year later, absolutely normal control.

CASE III.—In my third case I was obliged to follow a somewhat different procedure, as the sphincter pits were not well enough marked for me to be sure of their identity. After making the usual denudation I then made two incisions parallel to the sides of the anus and extending downwards from the denuded area about 1½ cm. on either side (see Fig. 5). On pulling apart the tissues and dissecting inwards, the sphincter muscle was then clearly exposed, freed from its bed, and the ends cut off (Fig. 6). The rectal part of the tear was now closed by interrupted sutures applied on the rectal side down to the sphincter area, and a short distance out onto the skin surface (Fig. 7). The sphincter ends were then denuded and brought together with buried interrupted cat-gut sutures passed through them, after which the rest of the wound was united as usual (Fig. 8), and the para-rectal incisions carefully closed with interrupted cat-gut sutures.

Since then the following cases given in abstract have been operated upon in my clinic by Drs. Russell, Ramsay and myself.

CASE IV.—B. D., married, age 23, white.

Diagnosis.—Complete tear of perineum.

Operation.—Restoration of ruptured recto-vaginal septum.

The patient has been married five years and has had two children and one miscarriage. The first labor was difficult and instrumental, at the second the child was still-born, while one month previous to admission, the miscarriage had taken place at four months.

Ever since the birth of the first child, three years ago, she has had a descensus of the womb, with bearing-down pains in the abdomen, pain in the back and headache, all of which symptoms have been worse during the past 3 months, the prolapse now being marked. The bowels move regularly every day.

Examination under ether showed: Extensive tear of recto-vaginal septum, through sphincter ani and up left sulcus, the tear apparently extending one inch into rectum.

Operation by Dr. Kelly, March 12, 1898. The usual Emmet denudation was made, and, in addition, the sphincter ends were dissected and pulled out on either side, 3 cm. on right and 2½ cm. on left, clear of all surrounding tissue. About 3 mm. of the ends were cut off to remove the white scar tissue and to present an even muscular surface; the ends were then sutured directly together with 4 cat-gut sutures and dropped and buried.

The septum was first united down to the sphincter, after which the sphincter was united, and then the remaining portion of bowel and finally the vagina and perineum. A silkworm-gut tension suture was inserted behind the sphincter ends but not so far posteriorly as usual. Duration of operation, 35 minutes.

Convalescence was uninterrupted; the healing was *per primam* and the result perfect; the patient had perfect control of the bowel from the very first. Maximum temperature 98.8° (2d day). Discharged well April 2, 1898.

CASE V.—F. G., married, age 26, white.

Diagnosis.—Retroflexio uteri; tear of the perineum, extending through the sphincter ani.

Operation.—Suspensio uteri; restoration of ruptured recto-vaginal septum.

The patient on admission complained of pain in the bladder and misery in the back. She had been married seven years; had had three children and no miscarriages. All three labors were difficult, the first two were instrumental, and in both these the outlet was lacerated with no attempt at subsequent repair. The last child was born two years ago.

The bowels were extremely constipated; she had hardly any control over them, especially as regards flatus.

Examination under ether showed: Outlet greatly relaxed; complete tear of perineum, extending through into bowel, the sphincter pits being distinct on either side; uterus in retroflexion.

Operation by Dr. Kelly, April 13, 1898.—Denudation in sulci and on lateral walls of vagina as usual, extending down to rectum and laterally to sphincter pits; ends of sphincter dissected out and caught with forceps; rectum brought together in the usual way by interrupted cat-gut sutures, tied on the rectal side; ends of sphincter muscle freshened and brought together with 4 cat-gut sutures; a deep silkworm-gut tension suture was also inserted behind the sphincter ends; rest of closure in usual way. Uterus suspended in usual way. Time of complete operation, 75 minutes.

The *convalescence* was marked by a partial breaking down of the perineal incision, with some suppuration, but the perineum was

well lifted up, and introduction of finger into rectum showed good sphincter action, except anteriorly, while the patient seemed to have good control over her bowels. The maximum temperature was 100° (on the 7th day). The patient was discharged May 10, 1898.

Subsequent note, Aug. 27, 1898.—Result of perineal operation is fair; some bulging of anterior vaginal wall, and pressure upon it and upon uterus causes discomfort. Sphincter ani has apparently its full power. Since leaving the Hospital the patient has improved in general health and is free from her old trouble, except some pain in the back and painful micturition.

Cystoscopic examination showed that the bladder was inflamed and infected, especially about the region of the trigonum, while the urine showed a great number of pus cells and a small amount of albumen.

Case VI.—L. E., married, age 30, white.

Diagnosis.—Complete perineal tear.

Operation.—Restoration of ruptured recto-vaginal septum.

Marital history.—Married four years, two children and two miscarriages. The first labor, three years ago, very difficult, although not instrumental; the patient was lacerated, and the laceration was repaired, but not successfully; the second labor, one year ago, was not difficult.

Since birth of first child, she has had prolapse of uterus after standing for some time, the uterus returning to its place on lying down. Has absolutely no control over her bowels and but little over urination. Feels as if bladder prolapsed with the uterus. The patient suffers with dragging pain in the back and loins. All these symptoms have been worse since the birth of her last child.

Examination.—Complete tear through perineum and sphincter ani muscle, about one inch of the bowel being seen. Uterus in anteposition, low down in pelvis. Outlet greatly relaxed.

Operation by Dr. Russell, April 28, 1898.—Tear extended 3½ cm. beyond sphincter into bowel. Sphincter ani ends were dissected out free; the mucous membrane was united above the sphincter by interrupted cat-gut sutures; the ends of the sphincter were then united directly with 4 cat-gut sutures, 1 tension silkworm-gut suture going from side to side through the skin and the septum. The outlet was then restored in the usual manner. Time of operation, 50 minutes.

The *convalescence* was uninterrupted; the bowels were well moved on the fourth day; the wound healed perfectly; the sphincter ani has good power, and the patient has perfect control of her bowels.

The patient's maximum temperature was 100° (2d and 7th days). The patient was discharged May 20, 1898.

Case VII.—M. B., age 32, married, white.

Diagnosis.—Large retroflexed uterus with descensus; lacerated cervix; complete tear of vaginal outlet with concealed tear of sphincter ani.

Operation.—Trachelorrhaphy; restoration of ruptured recto-vaginal septum; suspension of uterus.

Married 13 years; has had three children and one miscarriage; all three labors were prolonged and very difficult, and the perineum was badly torn each time, the worst tear being at the last delivery, three years ago. No one of the labors was instrumental.

Since the birth of her second child, six years ago, the patient has had dragging and bearing-down pains in the lower abdomen, aggravated by walking or climbing, with progressively increasing loss of strength and loss of weight. Micturition has been increased in frequency and is occasionally painful.

The bowels are generally regular, but, since the birth of the last child, she has had difficulty in controlling the fecal movements whenever the bowels are loose.

Examination.—Uterus is enlarged and retroflexed. The vaginal outlet is so relaxed that the cervix is visible. A tear is seen extending up the median line into the rectum about two cm. in length. Slight lateral indentations indicate the possible position of the sphincter ends and this is verified by palpation or stimulation; the sphincter retracts on all sides except in front. The lips of the cervix are everted and congested.

Operation by Dr. Kelly, June 18, 1898.

Dilatation and curettage with the removal of abundant endometrial detritus. The lacerated cervix was repaired next, and then the vaginal outlet, including the sphincter ends; after the denudation of the wound area the sphincter ends were dissected and drawn out to the extent of 1 cm. Some scar tissue was then cut off the ends to make them square and fresh. The rectal side of the tear was then closed with six cat-gut sutures down to the sphincter ends; the ends were then pulled out and held so, while *a silkworm-gut suture was passed through the skin, through one sphincter end across the septum and out through the opposite sphincter end and through the skin again.* The sphincter ends were then accurately approximated by three cat-gut sutures. The rest of the operation was performed in the usual way.

The uterus was also suspended through an abdominal incision. Time of complete operation, 55 minutes.

The *convalescence* was uninterrupted; the healing was perfect; the vaginal outlet was well lifted up, with the cervix in good position as well as the uterus and the patient had perfect control of her bowels. Maximum temperature 99.8° (third day). Patient was discharged July 16, 1898.

Case VIII.—E. N., married, age 47, white.

Diagnosis.—Multiple cervical polypi. Polyp of posterior vaginal wall. Rupture of recto-vaginal septum.

Operation.—Removal of polypi; amputation of cervix; repair of perineal tear.

Marital history.—Married at 18, seven children (oldest 25 years, youngest 5 years). Always had normal labors and was never attended by a doctor.

Menstrual history.—For the past six months has had frequent hemorrhages until a few (5 to 6) weeks ago, since then no flow at all. Associated with the hemorrhages were pains in legs and pelvic regions, which have continued up to the present time, occasionally associated with "colicky" pains in left hypochondrium. Bowels were usually regular up to the time of the hemorrhages, since which time they have been constipated. Micturition has increased somewhat in frequency of late. Urine is negative.

Examination under ether showed: Outlet gaping; complete tear of recto-vaginal septum, sphincter pits being definitely marked on both sides, with a bridge of scar tissue holding the ends of the muscles together. Several cervical polypi; one polyp of vagina; uterus enlarged, but in anteposition.

Operation by Dr. Ramsay, June 19, 1898.—Removal of vaginal polyp; amputation of cervix with its attached polypi; the denudation of the complete tear was made in the usual way to the sphincter pits; the ends of the sphincter muscle were caught, drawn out and dissected free. Cat-gut was used to draw together the bowel above the sphincter; the sphincter ends were then brought together with three cat-gut sutures, with a silkworm-gut suture *through the muscle* and the septum to relieve tension. The closure of the rest of the wound was performed in the usual way. Time of entire operation, 90 minutes.

The *convalescence* was uninterrupted; the healing was per primam, while by rectal examination the sphincter ani muscle could be felt contracting all around. The patient complained slightly of some pain in the left inguinal region which was relieved by enemata of starch water and fluid extract of Hamamelis. The maximum temperature was 100° (on 2d day). Patient was discharged well on July 20, 1898.

Case IX.—Mrs. C. H., married, age 36, white.

Diagnosis.—Complete perineal tear; relaxed vaginal outlet.

Operation.—Restoration of ruptured recto-vaginal septum.

The patient has been married 16 months and has had one child,

born 15 weeks ago; she was in labor three days, and the delivery was finally completed by instrumental interference, during which she was badly torn, both at outlet and cervix; an unsuccessful attempt was made to repair the septum. Since the childbirth she has had severe pains in back and pelvis, with partial loss of control of the bowels, especially marked when the movements are loose. As a rule however the bowels are constipated.

Examination under ether showed: Outlet much relaxed, with a tear through the recto-vaginal septum. Sphincter pits are easily seen, the one on the left side being pulled 2½ cm. from the position in which it is usually seen (apparently by the transversus perinei muscle). Uterus in anteposition and freely movable.

Operation by Dr. Kelly, June 27, 1898.—On palpation sphincter ani muscle felt easily posteriorly and laterally but not anteriorly. A verticle cut 1 to 1.5 cm. long exposed the sphincter ends. The sphincter was dissected out, the ends pulled out to the extent of 2 cm. and splinted by *a silkworm-gut suture passed through the muscle and up through the septum* and left untied for the present. The vaginal wound was closed, doing away with the relaxation; the rectal tear was closed and then the silkworm-gut suture was tied and the sphincter ends united by four cat-gut sutures, with two silkworm-gut sutures to perineum above and the rest cat-gut, making good closure throughout. Time of operation, 38 minutes.

The *convalescence* was uneventful until July 10, when, on the removal of the external stitches, although the wound had apparently healed well, the sphincter held well, and the patient apparently had perfect control of the rectum, it was found that there was a recto-vaginal fistula, the fistulous opening being around the internal vaginal suture on the left side. On the removal of this a good deal of soft fecal matter oozed through the opening, through which a sound 3 mm. in diameter could be passed.

This of course necessitated a *second* operation, which was performed on July 14, 1898. The sphincter was found to have held well; the fistula was just within the vagina and opened into the rectum about 1½ cm. within the anus. The sphincter was first dilated, and through the sphincter the rectal opening of the fistula was found; its edges were now pared and freshened on the rectal side; the vaginal side was then freshened in the same way. The rectal mucosa was closed with fine silkworm-gut sutures, with the knots turned into the bowel, and the vaginal opening was closed in the same way, with the knots toward the vagina. A rectal plug was then inserted.

The *convalescence* from this second operation was uneventful, except for the difficulty in moving the patient's bowels. Perfect healing took place, and the fistula was obliterated. The maximum temperature was 101° (sixth day after first operation). The patient was discharged on Aug. 2, 1898.

The patient was readmitted Sept. 9, 1898. She complained of pain at stool, which had been present ever since her discharge from the Hospital, with discharge of liquid material at times; the sinus seeming to heal for a day or two and then at stool to break down again.

Examination under ether showed: The sphincter ani muscle forms a *complete* ring around the anus, with normal radiating lines surrounding the orifice; while a sinus, slightly to the left of the median line in the perineum, opens just within the sphincter muscle; extending also 1½ cm. up in the recto-vaginal septum.

Operation by Dr. Russell, Sept. 14, 1898.—The sinus and the indurated tissue about it were dissected out; the opening in the rectum was enlarged by paring the edges and was then closed by five cat-gut sutures, passed on the rectal side. A few buried cat-gut sutures were also introduced on the perineal side. The perineal incision was then closed with interrupted silkworm-gut and cat-gut sutures. The *convalescence* was uninterrupted, the healing was perfect, the temperature never rose above 99°, and closure was complete. The patient was discharged Oct. 7, 1898.

CASE X.—C. C., married, aged 38, white.

Diagnosis.—Relaxed vaginal outlet. Rupture of sphincter ani muscle.

Operation.—Dissection and direct union of the ends of the sphincter ani. Resection of the relaxed outlet. Curettage of cervix.

Marital History.—Has been married 15 years. Has had four children, no miscarriages. All the labors were extremely protracted and difficult. The first and fourth labors were instrumental; the third child was still-born. After the birth of the first child she had convulsions. At her last labor she was badly torn, the tear extending to the anus, but no attempt at repair was made. Phlegmasia alba dolens complicated her last puerperium. The first child is fourteen years old, the last (if living) would be two. The laceration mentioned above has never troubled her. The bowels are perfectly regular and under control, while there is an increase in the frequency of micturition.

Examination under ether showed: Tear of perineum through sphincter muscle and 1 cm. into the bowels above; the ends of the muscle widely separated and connected by a narrow band of scar tissue; a slight bilateral laceration of cervix; uterus of normal size and in anteposition.

Operation by Dr. Russell, August 1, 1898. The operation was performed in two steps.

(1) A semilunar incision was made at anal orifice at junction of skin and mucosa, the flaps were dissected back and the ends of the sphincter ani muscle exposed; the mucous membrane was united by cat-gut sutures, and then the muscle ends were drawn together and sutured with five cat-gut sutures. The primary incision was then united from side to side.

(2) The relaxed vaginal outlet was then resected in the usual way. Time of entire operation, 50 minutes.

The *convalescence* was only interrupted by the inability of the patient to void her urine and the consequent necessity of catheterization for the first week, followed by a mild cystitis, relieved by vesical irrigations.

The maximum temperature was 100° (on the second and eighth days). The wound in the rectum healed per primam; perfect union of the sphincter muscle was obtained, with perfect control of the rectum. There was a slight infection of one of the vaginal stitches. The patient was discharged well, September 1, 1898.

CASE XI.—Mrs. C. W., married, aged 43, white. Private hospital.

Diagnosis.—Complete tear of the perineum.

Operation.—Repair of the complete tear. Dissection and direct suture of the sphincter ani.

The patient has been married 23 years and has had six children, the youngest three and a half years old, and one miscarriage in 1890.

She was badly lacerated at her first confinement, when the delivery was instrumental (22 years ago); this was repaired by Dr. Helmuth, in 1891, and the perineum was ruptured again at the birth of her last child, three and a half years ago.

She complains of general poor health, frequent attacks of diarrhœa, and especially of an escape of gas from the vagina; she has also noticed fecal matter in the vagina; and often has great difficulty and sometimes entire inability to control the movements of the bowel.

Examination showed: The vaginal outlet torn through and the sphincter ends widely separated; the perineum boat-shaped, with much scar tissue between the vaginal and rectal openings, and the injury to the sphincter ends might easily be overlooked; the sphincter ends marked by pits two cm. apart.

Operation by Dr. Kelly, November 22, 1898. Denudation as usual, removing scar tissue over sphincter ends and freshening the torn septum, extending up both right and left vaginal sulci. In including the sphincter ends, *the incisions marking out the area for denudation were made differently from the rule by*

cutting about three mm. away from the pits. This was done so as to give the sphincter a wider berth, so that when the sphincter ends were united by buried sutures they would not lie so close to the skin surface as they would if the incision was made close to the ends. Both sphincter ends were caught with forceps, pulled up and dissected out with a pair of blunt scissors until they appeared about one and a half cm. long above the surface. The glazed white ends were then cut off, and the rest of the denudation completed, and the bowel above freed from the recto-vaginal septum.

The rectal rent was then closed by fine interrupted silk sutures passed on the rectal side, *entering and emerging on the mucosa about one cm. from the margin of the cut.*

After closing the rectal rent, *the sphincter was united by two cat-gut sutures* and *splinted by silkworm-gut sutures entered about one and a half cm. back of the edge of the cut in the anal margin, and carried up through the septum, piercing the sphincter both on entering and emerging.* Another suture was passed well behind this first one, up through the septum outside the sphincter as recommended by Emmet.

The skin margin was very carefully closed up over the sphincter, and the rest of the wound in vagina and perineum united as usual, *extreme care being taken not to leave any dead spaces.* The intelligent patient had perfect control over the sphincter from the first, and at once recognized the great difference in her condition. She made a prompt recovery and returned home entirely well.

The one remarkable and constant fact specially noted after each of these operations was the immediate sense of restored power which was discovered by the patient as soon as she was well over the effects of the anesthesia; there was a sense of natural control over the function of the bowel which had been absent since the injurious confinement.

In conning the literature of this subject I have discovered several interesting references which have a direct bearing upon the method described. In the first place Dr. R. L. Dickinson,* has pointed out in an admirably clear paper devoted to the study of recent injuries to the sphincter ani, the important fact that the rupture of the muscles crossing the pelvic floor, in common with the external sphincter, is never median. The tear takes the direction of least resistance and avoids the aponeurotic web where the structures interlace in the middle line, breaking through laterally and severing the transverse perineal muscles and the sphincter well to one side. Out of sixteen cases ten were on the right, six on the left side, while another involved both sides of the sphincter. A close examination will always reveal an asymmetry, and not infrequently one end of the sphincter is found hanging out free on one side of the rupture, while the opposite side presents a deep pit from which it has been torn out. At the bottom of this pit is the other sphincter end. With the changes which take place during the period of cicatrization and contraction, well delineated by Kuestner and Leopold, this asymmetry is reduced to a minimum so that there finally remains but a slight obliquity in the level of the sphincter ends as a small index of a large difference earlier in the history of the case.

In these recent tears Dr. Dickinson with good surgical judgment used buried cat-gut sutures to bring the sphincter ends together; he says: "Two buried cat-gut sutures carried through the free hanging end of the muscle and then down into the pit to catch the hidden end, draw the parts into accurate apposition. The rest of the injury is then repaired as usual."

Sawaisky in an inaugural dissertation published in St. Petersburg, 1895, describes a method of treatment employed in Prof. Lebedeff's clinic in six cases of complete rupture. The recto-vaginal septum was first split as in performing a flap operation, and then after extending the wound sufficiently up onto the vulva the ends of the sphincter were caught and united with an interrupted suture, after which the major part of the wound was closed with a continuous cat-gut suture, and the closure was completed with four deep and two superficial sutures.*

In an article by Leopold and Wehle †, a method of uniting the sphincter is described by which two or three sutures are passed through the skin close to the sphincter, brought out in the sphincter pit and re-entered on the sphincter on the opposite side to reappear on the skin surface at a point corresponding to the point of entrance. By this means the suture ends are approximated with far greater accuracy and with a degree of certainty unknown in the old operation; this is practically the same method I have been practising myself for a number of years past.

Dr. George E. Shoemaker, in a personal letter received January 14th, 1899, states that he operated upon a tear of the sphincter ani muscle in June, 1893, which was referred to briefly in the *Medical News* of September 22d, 1894. Two previous operations, both unsuccessful, had been performed on the patient for the same trouble which had originated in 1891. Dr. Shoemaker's operation was begun by making a curved incision from over one sphincter end across to the other. The sphincter muscle ends were then dissected out and clearly defined, after which they were caught up by a strong cat-gut suture which included only the two sphincter ends. The rectal wall was closed in the usual way and the Emmet intravaginal denudation completed, two reinforcing worm-gut sutures being passed through the sphincter, each beginning far out on the skin at the side and ending at a point opposite.

The operation was entirely successful and the patient secured perfect control of the bowel.

Since this operation Dr. Shoemaker states that he has used this method repeatedly with entire satisfaction.

In a brief but suggestive paper Dr. R. G. LeConte‡ describes the direct suture of the sphincter ends by means of a buried cat-gut suture passed after the fashion of a tendon suture; the sphincter ends are hooked up and drawn forward and freshened either by cutting off a small portion with the scissors or by fraying the ends well with a knife, as already advised by previous operators who have insisted on freshening the sphincter ends as essential to secure good union; two cat-gut sutures are then applied one on each side of the sphincter muscle, and two more on the opposite side; when the opposed sutures are tied the sphincter ends are approximated. Dr. J. M. Baldy skilfully carried out Dr. LeConte's suggestion with remarkable success upon a patient who had been twice previously operated upon with an unsuccessful result each time.

*Amer. Gyn. and Obst. Jour., May, 1895.

*See reference in Frommel's Jahresbericht, Vol. 7, p. 202.

†Geburtsh. u. Gynaek., Bd. 2, Leipzig, 1895, p. 307.

‡Amer. Jour. of Obst., June, 1895.

FIG. 1.—Showing the natural appearance of orifice after six attempts to restore the sphincter and secure control over the bowel function. The dotted line shows where the incision was made to expose the sphincter ends. A and B are pulled apart as shown in the next figure.

FIG. 3.—Appearance after the union of the sphincter ends and the closure of the skin wound, with interrupted silk sutures.

FIG. 2.—Shows the sphincter ends as they were found on pulling flap A up and flap B down. The right end lay near the median line and the left displaced attached close to the tuberosity of the ischium. One of the catgut sutures in place ready to bring sphincter ends together.

FIG. 4.—Showing skin flap held down and sphincter ends united by 3 interrupted catgut sutures. This was a case of deep injury of the sphincter without tear of the skin over the anus and without a tear into the lumen of the bowel.

FIG. 5.—The denudation on vaginal and perineal surfaces. The tongue of tissue in the middle lifted up and dissected loose from the internal sphincter (i. s.). The denudation does not, however, expose the external sphincter, which is in this case laid bare by the two incisions (Inc) parallel to the anal orifice.

FIG. 6.—The incisions made as shown in Fig. 5 and the sphincter ends bared by dissection.

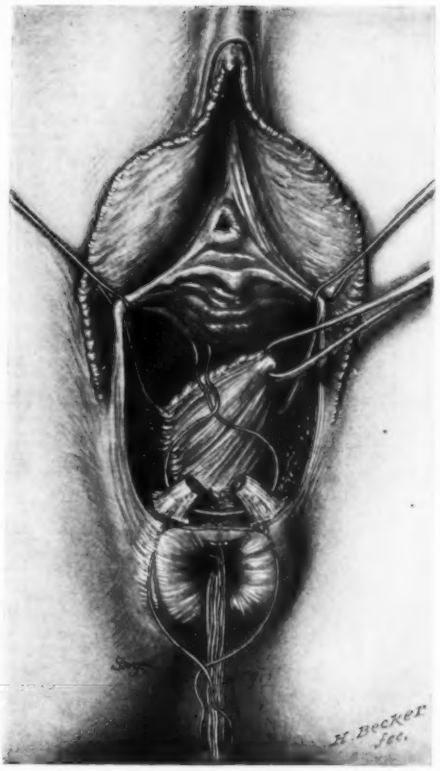


FIG. 7.—Denudation completed and rectal sutures tied, uniting the internal sphincter and radiating out into the skin surface.

FIG. 8.—The rectal sutures all in place and the sphincter (Sp) ends united by 3 buried catgut sutures. A silkworm-gut tension suture passes through the centre of the sphincter muscle up around through the septum.

My own method of treating the sphincter is similar to those detailed, in so far as the muscle is united directly end to end by means of buried interrupted cat-gut sutures, and I would prefer passing single sutures directly through the muscle to the use of tendon sutures, for the reason that the simple interrupted suture buries less foreign material, and it is therefore less liable to infection, lying as it does close under the skin.

The first essential point of difference between my own method and those of previous operators is a carefully conducted denudation, giving the sphincter a wider berth, so as to separate it from the skin surface, after all the parts have been brought into apposition, by a greater interval. This is done to make the burial of the cat-gut sutures a safer procedure.

The next important point is the dissection and liberation of the sphincter ends until one, or one and a half centimeters or even more are pulled out free on each side. This has not been proposed before. The ends are then cut off so as to remove the scar tissue and three interrupted cat-gut sutures passed through them so as to be ready to bring them snugly together at the proper time.

The rectal wound is then completely closed by a series of interrupted sutures passed close together so as to make it impossible for any minute particles of fecal matter to press between the stitches and cause an infection. This closure is carried down and over the anus onto the skin area, and then, only after this step is satisfactorily completed, are the sphincter ends brought together and the buried cat-gut stitches tied. Another point which I wish to urge, which differs from any previous proposition, is the passage of a silkworm-gut tension suture directly through the substance of the sphincter muscle half way between its outer and inner borders. The purpose of this suture is to take the tension off from the buried cat-gut sutures during the healing process. I prefer this suture to the Emmet tension suture which is passed well behind the sphincter ends on the skin surface, because my suture acts more directly and does not tend to make the anal orifice so small; it is therefore easier to secure earlier and regular defecation.

I have dwelt thus far upon the method of securing immediate union of the external sphincter muscle; it is my desire now in conclusion to insist upon the importance of paying equal attention to securing accurate approximation of the internal sphincter muscle. Indeed, if I would establish any comparison between the two, I would attribute more importance to the accurate union of the internal sphincter than to that of the external. This must be effected in the following manner: One or two fingers are passed into the torn bowel and the thin septum is brought slightly forward, while with a knife or a pair of scissors the operator splits the septum on its mucous margin and then dissects upwards and inwards, separating the vagina and its columna from the septum in such a way as to isolate the rectum in front and on the sides. By taking a little care and observing the tissues closely, the bowel with the muscle is easily set free, and if the dissection is well done the internal sphincter fibres will be clearly recognized on both sides.

After all the scar tissue is removed the internal sphincter is then united by a series of interrupted fine silk sutures entering and emerging on the mucous surface of the bowel about a millimeter from the edge of the cut. These sutures are passed and tied from above downwards from one and a half to two mm. apart; in a case recently operated upon I used as many as sixteen of them before the bowel was closed down beyond the external sphincter.

I believe it is best to reinforce these rectal sutures by two or three cat-gut sutures buried in the septum above them and grasping the muscular coat of the bowel, that is to say, the internal sphincter, and drawing it together over the line of union established by the first set. After doing this the external sphincter is brought together as described above, and the remaining perineal and vaginal portions of the wound united as described in the text-books. The utmost care must be taken throughout not to leave any dead spaces in the septum or about the buried sutures.

After such an operation it is my practice to open the bowels at least every other day by giving a warm oil injection through a soft catheter.

NOTE.—I have received a communication from Dr. J. M. Baldy, of Philadelphia, under date February 9, 1899, in which he refers in detail to his own practice of suturing the sphincter muscle directly in the following language:

"As to the method I am using, at first I made a partial ligation of both ends of the muscle, after dissecting them out and freeing them for a quarter of an inch from all attachments. After securing the muscles with catgut the balance of the operation was performed like Emmet's. I found in several cases that the ends of the muscle sloughed—one case resulted in a cure, another did not, and I had to do it over. Consequently I changed the method to a simple suture of the ends as I would suture the ends of anything else, ligating as it were only one side, so as to give more security in holding the ends together, and at the same time save the chance of cutting of the muscle circulation and producing a slough. Then I finish as an Emmet, passing the lower sutures (silkworm-gut) through the sphincter far below the points of union so as to take off all tension from the catgut in the muscles.

When I get a very tight sphincter (or anus) I slip a small subcutaneous knife into the tissue at the posterior margin of the anus and sever as many of the sphincter fibres posteriorly as it is necessary to allow me to stretch the anus sufficient to give a free opening—that is, enough to allow the easy passage of my thumb. I always stretch the torn sphincter before beginning any denudation or dissection whatever.

The patients have sure and absolute control before they leave the Hospital. It is a big improvement over the old methods."

DESCRIPTION OF THE JOHNS HOPKINS HOSPITAL.

BY JOHN S. BILLINGS, M. D., LL. D.

Containing 56 large quarto plates, phototypes, and lithographs, with views, plans and detail drawings of all the buildings, and their interior arrangements—also wood-cuts of apparatus and fixtures; also 116 pages of letter-press describing the plans followed in the construction, and giving full details of heating-apparatus, ventilation, sewerage and plumbing. Price, bound in cloth, $7.50.

ABERRANT PORTIONS OF THE MÜLLERIAN DUCT FOUND IN AN OVARY.*

By Wm. Wood Russell, M. D., *Associate in Gynæcology, Johns Hopkins University, Baltimore.*

The specimen which I present this evening is of extreme interest, because it brings up the much-disputed question as to the derivation of the gland-like spaces as well as the papillary and adenomatous tumors of the ovary: whether they take origin from the germinal epithelium, the remains of the Wolffian body, or the Graafian follicle. In the light of our present knowledge of the development of the urogenital system I am actuated, from the study of this specimen, to add another possibility to these just mentioned.

Accepting the studies of Nagel, that the epithelial elements of the Müllerian duct are derived from the germinal epithelium, as correct, I believe we are able to explain the condition found in this instance as due to an anomalous point of development of portions of the Müllerian duct in the germinal epithelium.

The ovary from which the slides were taken was removed January 2d, 1897, during an operation for a cystic adenocarcinoma of the left ovary.

As is the custom after removing a pelvic tumor, the other pelvic organs were inspected, and in this case I found the opposite ovary enveloped in adhesions on the posterior surface of the broad ligament, while the tube was free and patent. The patient having reached the age of the natural menopause, I decided that it was best to remove it, to relieve her of any future anxiety. Nothing unusual was noticed about the ovary, it being of normal size, the outer pole cystic and the surface covered with shreds of adhesions. The uterus was also normal.

The specimens were hardened in Müller's fluid, cut, and stained with hæmatoxylin and eosin.

On microscopic study of the right ovary, we were astonished to find areas which were an exact prototype of the uterine glands and interglandular connective tissue. Further search through serial sections of the remainder of the ovary revealed similar foci scattered throughout the specimen in which the glands and interglandular connective tissue were in many places surrounded by bundles of non-striped muscle. On the posterior surface at a considerable distance from the hilum, was a shallow groove partly filled with glands of the uterine type, opening on the abdominal side. The epithelium covering this group gradually merged into a single layer of low columnar cells and at the edges of the groove spread out over the surface for a short distance as the germinal epithelium.

A large corpus luteum which occupied the outer pole was two-thirds surrounded by a narrow space lined with columnar epithelium. In places this epithelial lining dipped down into the tissues beneath, and formed gland-like structures.

In the substance of the ovary were spaces lined with columnar epithelium in places having distinct cilia. Beneath this was a band of glands imbedded in connective tissue. The glands were arranged as in the normal uterine mucous membrane and opened into the spaces, their epithelium being continuous with its lining membrane. The interglandular connective tissue was composed of small cells with darkly staining oval and round nuclei almost completely filling the cell body, in fact identical with that found in the uterus.

Beneath the spaces were bundles of muscle, arranged more or less concentrically, with strands running off into the ovarian tissue.

Leucocytes and red-blood corpuscles with indistinct outlines partly filled the spaces. The whole formed an exact reproduction of a portion of the uterine mucous membrane and muscle. The arrangement of these structures gave the impression that they were a continuous system from the groove (Plate I, Fig. 3) on the posterior surface to a cystic space in the anterior face (Plate II, Fig. 2).

The ovary contained many corpora fibrosa and a few Graafian follicles in various stages of development; some of which were cystic. In many places throughout the specimen were foci of pigment in the ovarian tissue, in some of which the shrunken forms of red-blood corpuscles could be seen, being evidently the remains of hæmorrhage. The hilum did not contain any of these glandular structures, but appeared normal, except for a sclerosis of the vessels.

Williams[1] remarks, concerning the origin of epithelial elements, in the ovary: "Indeed, the number of theories advanced has been limited only by the number of structures entering into the composition of the ovary." I will not attempt, therefore, to review the subject, but state briefly the most important of the theories.

Germinal Epithelium.—Anomalies of growth in the germinal epithelium have, in many instances, been held responsible for these structures.

Waldeyer's[2] conception of the origin of the Graafian follicle, from nests of cells forming in the germinal epithelium and then being isolated from the other cells by connective tissue penetrating the area from below and surrounding these nests, is now accepted by, practically, all recent observers.

The Valentine-Pflüger theory which ascribed the origin of the Graafian follicle to specialized tubes, the so-called Pflüger's ducts, formed by the germinal epithelium dipping down into the substance of the ovary has therefore lost its significance, and the hypothesis dependent on it for an explanation of the origin of epithelial tumors of the ovary should be discarded.

In a later investigation Waldeyer decided that these gland-like spaces were accidental inclusions of germinal epithelium occurring either in fœtal or adult life.

Marchand[3] was the first to call attention to the close relationship between the germinal epithelium and the epithelium of the Fallopian tube, stating that primarily they have a common point of origin. He believed that the epithelium of the tube could extend out over the surface of the ovary, and by penetrating the stroma of the ovary produce tubules similar to

* Read before the Johns Hopkins Medical Society, April 4, 1898.

Pflüger ducts. From these, he argued, cysts might arise, and he further remarks on the histological resemblance between the mucous membrane of the tube and papillary tumors of the ovary.

Williams also traced a small papillary cyst in the ovary to a prolongation of the epithelium from the tubo-ovarian fimbria.

Shortly after the appearance of Marchand's paper, DeSinety and Malassey[4] described some interesting specimens in which they discovered tubes lined with epithelium running in various directions through the ovary and opening on the free surface, the epithelium at these places being continuous with the germinal epithelium. They considered these structures as analogous to Pflüger's duct, but formed in adult life. Since then, these observations have been frequently confirmed.

Nagel,[5] Gusserow and Eberth[7] believe that the germinal epithelium may be incited to papillary growths by inflammatory reaction about the ovary, Nagel having seen the germinal epithelium preserved beneath adhesions.

Graafian Follicle.—From the beginning of the scientific investigation of the genesis of ovarian tumors the Graafian follicle has played a prominent rôle. Frommel[8], in 1890, formulated a hypothesis, but was unable to prove it by actual finding. He had found a superficial papilloma of the ovary, which undoubtedly sprung from the germinal epithelium, and believed from this that the membrana granulosa of the Graafian follicle, being a derivative of the germinal epithelium, could produce similar growth.

Williams in 1894 found in what he considered a dilated Graafian follicle a papillary outgrowth from the membrana granulosa. Yet the question is by no means definitely settled that the membrana granulosa is a derivative of the germinal epithelium. Waldeyer's theory undoubtedly explains the manner in which the ovum becomes embedded in the ovarian tissue, but whether the cells lining the follicle are epithelial or connective tissue in origin remains unsolved.

Wolffian Body.—The Wolffian body, on account of the proximity to the ovary in the early development of the urogenital system, has been offered by many writers as a probable source of these glandular structures, but of this there is absolutely lacking scientific proof. The possibility that some of the tubules of the primitive kidney may be caught in the germinal epithelium while it is budding out to form the ovary cannot be denied, but I believe that if such an event should occur these tubules would retain their original characteristics and not be transformed to the type of those arising from the Müllerian duct.

Müller's Duct.—Recently, Kossman[9] has, with great skill, discussed the subject from a new aspect in connection with his work on accessory Fallopian tubes. He insists that all intraligamentary cysts reaching considerable size spring from rudimentary tubes lying in the broad ligament, which he has found to exist in about ten per cent. of women. His arguments which appear most plausible are as follows:

The secreting portion of the primitive kidney, the glomeruli, disappears completely during intra-uterine life and may, therefore, be left out of consideration. The parovarium, parooöphoron and Gartner's duct are simply conducting channels during fœtal life, and their epithelial lining has at no time in their history secretory power. If it had, they would sooner or later all become cystic, as they have no external openings. On the other hand, the mucous membrane of the tube has undoubtedly the power of secretion, and by occlusion of its openings always forms a cystic tumor, hydrosalpinx. He draws a sharp distinction between the embryological germinal epithelium during the formative stage and that of a later period. After the differentiation of the epithelium into its various parts, these specialized parts are entirely distinct in their character and without power of further reproduction. The germinal epithelium, after the developmental stage, remains functionally inactive and exists only as a single layer of epithelial cells covering the surface of the ovary.

All tissues of the body are subject to the rule that after differentiation has once taken place in fœtal life, one can never be transformed into another. Further, the papillary growth covered with ciliated cylindrical epithelium has, in this region, its only analogue in the tube. This holds good for the tube, ovary and broad ligament. Those arising in the ovary are from isolated plaques of epithelium of the fimbriated end of the tube which have become differentiated from the germinal epithelium at an abnormal point.

At this point it is important to understand the present views in reference to the origin of the epithelium of the Müllerian duct.

There has been a wide diversity of opinion on the subject, and several theories advanced, some believing that it is derived solely from the Wolffian duct, others from a specialized portion of the peritoneum, and yet others, partly from the germinal epithelium and partly from the epithelium of the Wolffian duct. To Waldeyer belongs the credit of first calling attention to the formation of the groove in the germinal epithelium which later becomes the Müllerian duct. Its significance, though, was not fully estimated until the appearance of Nagel's[5] work, who substantiated Waldeyer's observation, and further discovered that the germinal epithelium at the point contained the so-called sexual cells which are the progenitors of the ovules in the females. In following the further development of the Müllerian duct, he finds that the primitive groove closes at its distal end, forming a blind tube which sinks into the Wolffian body and pushes backward beside the Wolffian duct, but remains throughout absolutely independent of it.

The conclusion to be drawn from this is, that the epithelium of the Müllerian duct is exclusively derived from true germinal epithelium.

If we accept this view of Nagel it is not difficult to conceive that a portion of germinal epithelium which forms the ovary should, at times, attempt to produce structure which its function elsewhere calls upon it to do.

Such an accident may be represented by simple tubes or spaces lined with ciliated columnar epithelium of the tube, or villous and papillary growth analogous to the mucous membrane of the tube or even the more complicated structure of the uterus, glands, interglandular connective tissue and muscle.

In the specimen which I have described there is a collection

of glands in a groove on the surface of the ovary. The epithelium covering them is continuous with a single layer of columnar cells at the margin of the groove and extends a short distance over the surrounding surface. Thus we have direct proof that the germinal epithelium is capable of producing glands analogous to those of the uterine mucosa.

Burkhard[10] has described a very interesting small multilocular cyst of the ovary in which was found non-striped muscle and glands. On the surface of the tumor were several nodules made up of involuntary muscle, throughout which were scattered small round cysts lined with ciliated epithelium. He ascribes these structures to the germinal epithelium, but does not associate them with the Müllerian duct. He has neglected to describe minutely the character of the connective tissue immediately surrounding these structures and I am unable, therefore, to determine if the specimen resembles the above in that particular.

Since writing the above, von Franque[11] has published the preliminary report of an ovary which apparently confirms the Wolffian body theory. His remarks are so brief that one is not justified in criticism, but it would seem that he has in his case positive evidence that the parovarial tubules can, as we have already suggested, enter the ovary through the hilum and produce these glandular formations.

I shall be able in a short time to produce further evidence that this theory holds good for the origin of epithelial tumors of the ovary, as I have discovered in the wall of the cyst of the opposite ovary structures identical with those described.

Discussion.

Dr. Barker.—The case is interesting to anatomists on account of its relation to the topic of the origin of the sexual ducts in man. In the development of the sexual organs of higher animals a curious transformation of organs used in other animals for very different purposes appears to have taken place. A comparison of the three pairs of kidneys of lower forms, the front, middle and hind pairs, and their special ducts with the structures met with in higher forms show that the ducts from the front pair correspond to Müller's ducts, those from the second pair to the Wolffian ducts, and those from the third pair to the ureters. The front pair of kidneys (Pronephros) never appear in human embryos, and yet strangely enough their ducts do appear. The middle pair of kidneys (Mesonephros) are represented in the human being by the Wolffian bodies; the third pair (Metanephros) are the functional kidneys of human beings.

Now as the need for more complicated sexual organs arose, it appears that the two front pairs of kidneys and their ducts were utilized to build them, those of the front pair being used for the organs of the female, and those of the middle pair for the genital organs of the male. The Müllerian ducts of the two sides ordinarily fuse in their lower two-thirds to form the uterus and vagina. The upper third on each side corresponds to the Fallopian tube of that side. In the male, the part corresponding to the Fallopian tube disappears; that corresponding to the uterus forms the *utriculus prostaticus*, the lower part disappearing entirely. In the female the Wolffian body, or middle kidney, is embedded as the paroöphoron in the hilus ovarii, the little ducts going to form the parovarium and the lower portion constituting Gartner's duct or the ductus epoöphori longitudinalis, a little tube which runs parallel to the vagina. In the male the Wolffian body (Mesonephros) is represented by the paradidymis or organ of Giraldes. The Wolffian duct gives rise to the ductuli efferentes testis, the epididymis, the ductus deferens, the ductus ejaculatorius and to the vesicula seminalis with its ductus excretorius. It seems likely that Skene's tubules in the urethra of the female are derived from the Wolffian duct in which event they might, perhaps, be fairly looked upon as the structures corresponding to the seminal vesicles and ejaculatory duct of the male.

The study of the embryology of these structures is essential for a clear understanding of the normal anatomy, and especially for the comprehension of the deviations from the normal mode of development met with in cases of hermaphroditism, etc. The pathology of various conditions first becomes luminous when the developmental relations are considered. The case which Dr. Russell has just reported would be extremely difficult to interpret had not the proximity of Müller's duct to the germ-cell masses been well established.

The case he has so carefully described is an extremely rare one, indeed I believe it is the only one on record. It is especially interesting that a portion corresponding to the uterus should be that which appears imbedded in the ovary.

Literature.

1. Williams: Papillomatous Tumors of the Ovary. The Johns Hopkins Hospital Reports, Vol. III.

2. Waldeyer: Eierstock und Ei. Leipzig, 1870.

3. Marchand: Beiträge zur Kenntniss der Ovarialtumoren, Halle, 1879.

4. DeSinety and Malassey: Sur la structure, l'origin et le developpment des kystes des ovaires. Archiv de Physiol., 1878.

5. Frommel: Das Oberflächen-Papillom des Eierstocks, seine Histogenese und seine Stellung zum papillären Flimmerepithelkystome. Zeitschr. f. Geb. u. Gyn., Bd. 19, 44.

6. Nagel: Beitrag zur Genese des epitheliomen Eierstockstumoren. Arch. f. Gyn., 33, 1.

7. Gusserow and Eberth: Grosse fibröse Papillome beider Ovarien. Virchow's Arch., Bd. 43, 14.

8. Kossman: Zur Pathologie der Urnierenreste des Weibes. Monatschrift f. Geb. u. Gyn., Vol. 1.

9. Nagel: Über die Entwickelung des Urogenital Systems des Menschen. Archiv. f. Mikroscop. Anat., Vol. 34.

10. Burkhard: Zur Genese der multiloculären Ovarialkystome. Virchow's Archiv, Vol. 144, 1896.

11. Von Franque: Über Urnierenreste im Ovarium, etc. Sitzungs-Berichte der physikalich-medicinischen Gesellschaft zu Würsburg, July 7, 1898.

FIG. 1.—Natural size, showing normal tube with patent fimbriated extremity. Ovary posterior view with portion of adventitious capsule.

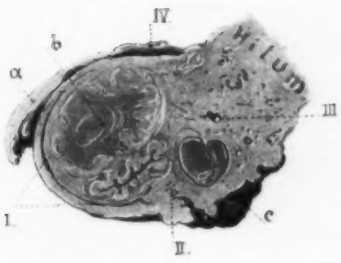


FIG. 2.—Longitudinal section through centre of ovary.

I. Space partially surrounding corpus luteum (*b*) lined with epithelium, in which on lower side glands were present.

II. Groove, at bottom of which is a wedge of tissue made up of glands and interglandular tissue covered with a single layer of epithelium continuous with that on the surface.

III. Space lined with columnar epithelium and surrounded by mucous membrane of the uterine type and non-striped muscle.

IV. Point beneath adhesions, (*a*) where germinal epithelium was preserved. (*c*) Cystic follicle.

FIG. 3.—Longitudinal section through ovary and hilum posterior face. (Magnified four times.)

I. Corresponds to I, Fig. 2. In the lining of the space toward the centre of the ovary is seen distinct gland formation.

II. Corresponds to II, Fig. 2, in which the glands can be plainly seen, some of which are cystic.

II'-II''. Groups of glands near surface of ovary surrounded by distinct stroma of uterine type.

III. Space surrounded by mucous membrane and muscle, an exact prototype of the uterine mucosa and muscle, some of the glands cystic, corresponds to III, Fig. 2.

IV. Germinal epithelium in adhesions. (*a*) Adhesions forming capsule. (*b*) Corpus luteum. (*c*) Cystic Graafian follicle. Right corner of section represents vascular zone of hilum, entirely free from glands.

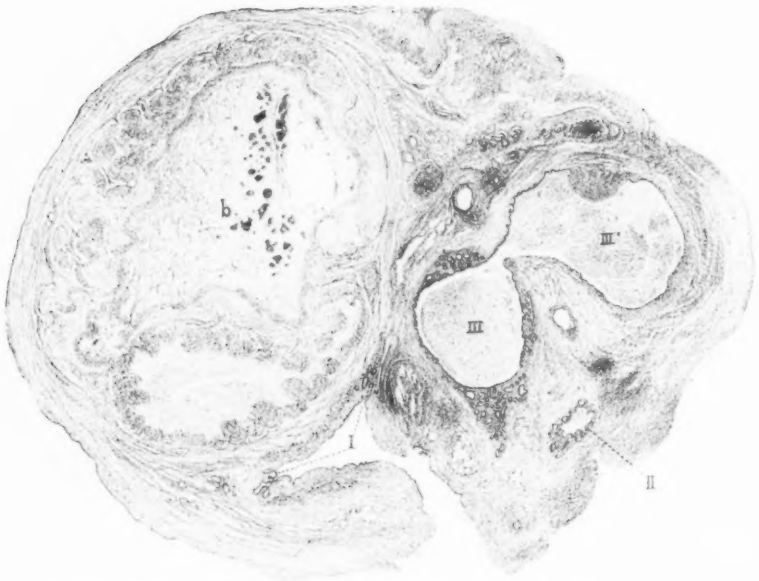


FIG. 1.—Longitudinal section through centre of ovary without hilum. (Magnified four times.)

I. Groove described in Plate I.

II. Glands surrounding space near the capsule with stroma.

III–III′. Two large spaces in centre of ovary communicating by a narrow strait.

III. Space completely surrounded by mucous membrane and muscle, and lined with columnar epithelium, which is in places ciliated. The membrane becomes thinner as it approaches the strait, and just as it passes over into space III′, becomes a single layer of columnar epithelium.

Space III′. The cells forming its lining become gradually lower, merging first into cuboidal, and at the furthest point from the strait are flat. The knot-like projection in upper border of III′ is an organizing blood clot, covered at the base by flat cells. (*b*) Corpus luteum.

The contents of the spaces are made up of partly disintegrated red-blood corpuscles, leucocytes and granular debris.

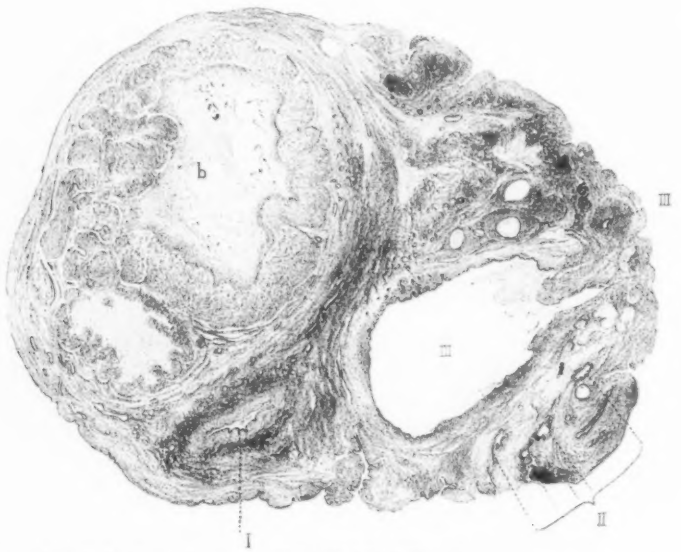


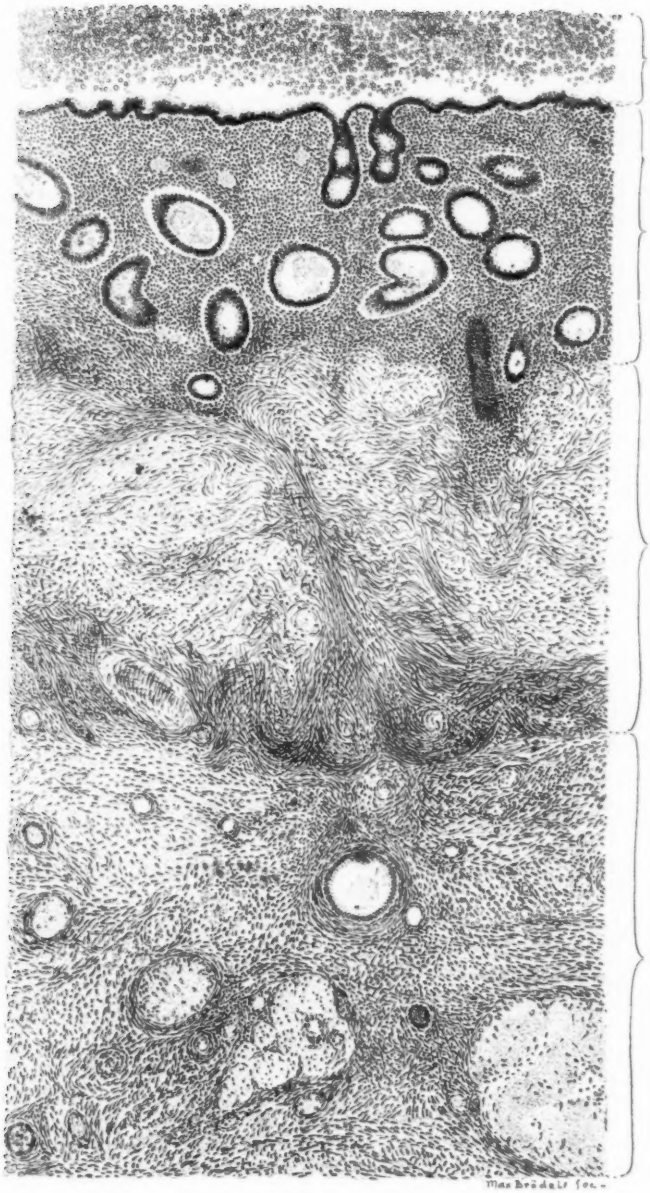
FIG. 2.—Longitudinal section through anterior face of ovary. (Magnified four times.)

I. Space in lower border of parenchyma of ovary lined with columnar epithelium, in which, at places, is distinct gland formation.

II. Groups of glands in and beneath capsule.

III. Large cystic space surrounded in greater part by connective tissue of the type found in the uterine mucosa. Most perfect glands along the left upper border.

III¹. Group of glands. (*b*) Corpus luteum seen in other sections.



(*a*) Blood corpuscles forming part of contents of space.

(*b*) Typical uterine glands and stroma, two of the glands opening into space, and whose epithelial lining is continuous with that of the space.

(*c*) Non-striped muscle resembling that of the uterine wall.

(*d*) Normal ovarian tissue containing Graafian follicles in various stages of development and corpora fibrosa.

Portion of wall surrounding space III, Plate II, Fig. 1 (magnified 75 times), section through mucous membrane and muscle down into normal ovarian tissue.

THE CAUSE AND SIGNIFICANCE OF UTERINE HEMORRHAGE IN CASES OF MYOMA UTERI.

A STUDY BASED UPON THE ARTIFICIAL INJECTION OF TEN SPECIMENS OF MYOMA UTERI AND FURTHER VERIFIED BY THE CLINICAL AND PATHOLOGICAL REVIEW OF ONE HUNDRED OTHER CASES.

BY J. G. CLARK, M. D., *Associate in Gynecology in the Johns Hopkins University, late Resident Gynecologist in the Johns Hopkins Hospital.*

Some three or four years ago, on searching through the current medical literature and the generally accepted text-books for an explanation of the hemorrhage so frequently accompanying myoma uteri, I was surprised to find very little unanimity of opinion upon the subject. Many writers merely state that hemorrhage is a frequent clinical symptom of these tumors, but attempt no explanation of this phenomenon. Others make the more definite statement that hemorrhage is less frequent the further the tumor is situated from the uterine mucosa, while still others quote the explanations of Wyder, v. Campe, Schmal and Semb, to which I shall refer later. With a view therefore of throwing more light upon this subject or at least of confirming the results of some one of the preceding investigators, I began the study of the macroscopic appearances in conjunction with a close analysis of the clinical history of specimens of myomata removed by hysterectomy. The observations, however, upon which I have relied most for my conclusions have been made in a series of ten artificial injections of the principal varieties of tumors. In my early study of these cases the fact had frequently impressed itself upon me that the mere size of the tumor bears absolutely no relationship to the amount of hemorrhage, for in some instances tumors as large as the pregnant uterus at term have been accompanied at no period of their development by this symptom, while, on the other hand, tumors so small as not to be perceptible to the patient have induced such excessive bleeding as to require operative treatment most urgently. Again the frequency of hemorrhage accompanying the submucous tumors and its absence in the subperitoneal types was self-evident.

In view of these general observations and the fact that on section myomatous tumors as a rule show a very poor vascularization, the explanation of the hemorrhage did not appear at first sight to be due to the tumor *per se*, but to mechanical disturbances induced in the uterine circulation through its presence. Myomatous tumors, as is well known, present a most remarkable morphological diversity; their size, form and position being subject to the widest variation from any fixed standard of development, due not to deviations from their primitive histological basis, for within narrow limits they conform more or less closely to a uniform microscopical type, but to variations in their gross anatomy. For clinical purposes these tumors are classified according to their location into subperitoneal, interstitial and submucous varieties, but comparatively seldom do we find a given specimen composed solely of any one of these types, for they are usually scattered indiscriminately throughout the uterine wall, some appearing as subperitoneal bosses, others as rounded nodules completely surrounded by uterine muscle, while still others project into the uterine cavity as submucous tumors.

Besides this multiplicity frequently single tumors are observed which partake more or less of the characteristics of all the other types; thus an interstitial tumor may project into the uterine cavity and besides present an equally extensive surface beneath the peritoneum.

In view of the heterogeneous growth of these tumors it would appear evident that any rule governing the hemorrhage which has a mechanical basis for its support must present many variations. The atypical bleeding in cases of myoma uteri may manifest itself therefore as an increase in the catamenial flow or as profuse and irregular inter-menstrual hemorrhages. Were the tumor itself to possess inherent characteristics which induce hemorrhage it goes without saying that in all cases this symptom would occur.

The splendid collection of myomata in the Gynecological Department of the Johns Hopkins Hospital contains one specimen which illustrates especially well the fallacy of the latter hypothesis. The tumor, a picture of which has already appeared in Kelly's Operative Gynecology, Vol. II, opposite p. 382, is a large angiomatous myoma, occupying the wall of the uterus but not impinging upon the mucosa. Notwithstanding this excessive vascularization the patient did not suffer from hemorrhage and came to operation simply on account of the steady increase in the size of the tumor.

Accepting as an axiom that "to determine the abnormal one must know the normal," it appeared to me absolutely essential to ascertain first the normal scheme of the uterine circulation before attempting to arrive at any conclusion concerning the changes induced in it by the growth of myomatous tumors. The following brief consideration of this subject will therefore not be out of place, for in addition to rendering an explanation of the atypical hemorrhages occurring in cases of myoma uteri easier, it also demonstrates the fact that our preconceived ideas of the vascularization of the uterus drawn from text-books in anatomy and gynecology are in certain details fallacious.

THE NORMAL CIRCULATION OF THE UTERUS.

In beginning the experimental injections of the uterus, I considered it essential to define the areas supplied by the four arteries (two ovarian and two uterine) terminating in the uterus.

The most commonly copied picture of the circulation is that of Hart and Barbour (Gray's Anatomy), which represents the uterine and ovarian arteries as a thick tortuous communicating system lateral to the uterine walls, giving off branches which in turn quickly break up into tiny vessels terminating in a fine capillary anastomosis in the median line of the uterus. From this cut as well as from the descriptions by the majority of writers it would appear that not only is there a

poorly vascularized median line, but that there is little if any commingling of blood from the two sides except through this capillary anastomosis.

This idea, as I shall show, may be demonstrated as erroneous by artificial injections of the uterus. In my first injection experiments I employed an aqueous solution of Prussian blue. Cannulæ were inserted into the two uterine and two ovarian arteries, and the injection was begun by forcing the fluid first into the uterine artery of one side. Before even the peritoneal covering of the uterus was darkened the injection fluid had rushed through the lateral communication between the ovarian and uterine artery, and began to flow from the ovarian artery, thus showing that there is absolutely no bar to the reflux of blood from the uterine to the ovarian artery or vice versa, and that under normal conditions of the circulation the cardiac force transmitted through the uterine and ovarian vessels must act conjointly in forcing the blood from the utero-ovarian circle lateral to the uterus into their ultimate terminals. Another phenomenon, which was especially noteworthy, was the rapid crossing over of the injection fluid to the opposite side of the uterus, where it escaped, not from the vein, *but from the uterine artery*, and only after the latter was clamped did the fluid begin to escape from the efferent vessels. From the initial point of injection the entire uterus was deeply colored with the blue solution, demonstrating the existence of a very easy communication between the myriads of vessels ramifying throughout the uterus. Whether this communication was established through capillaries or whether through the direct anastomosis of larger vessels, I was not able to determine from this experiment; but still clinging to the idea set forth in the text-books I was disposed to accept the first hypothesis.

Still with the intention of defining separate areas supplied by each of the vessels I resorted to the use of a granular injection mass, consisting of ultramarine blue suspended in 10 per cent. gelatine, knowing that the granules would only pass down to the capillary system but not through it. Upon attempting this I was surprised to find that the same phenomena occurred as in the first experiment, demonstrating beyond doubt that there is, in addition to the usual capillary communication, a direct arterial anastomosis between the intra-uterine vessels, which is not an insignificant one, but plays a most important part in the circulation of the uterus.

When I related the phenomena noticed in my first injections, conducted in the anatomical laboratory of the Johns Hopkins University, to Prof. Spalteholz of the University of Leipzig, I found him disposed to cling to the older opinions and to think that possibly there was some error in my injection technique. Later, however, when making injections of the uterus from which to have pictures drawn for his anatomical atlas, he obtained identical results, and will depict in his forthcoming volume a direct arterial communication between the two lateral utero-ovarian circulations.

When we consider the varying physiological phases through which the uterus passes (the most important of which—the puerperal state—is dependent upon an abundant and unfailing blood-supply), this provision of nature, whereby an easy communication is established between its four arterial sources, not only through a capillary system like that of other organs, but also through a more direct arterial anastomosis, appears to be absolutely essential. To leave the nutrition of any portion of this important organ to the care of one set of vessels, which might become impaired, would undoubtedly render it liable at any time to serious functional disturbances.

To briefly epitomize the results of my observations on the normal vascularization of the uterus, I would say that it consists of the lateral utero-ovarian anastomosis which give off excessively tortuous secondary branches, some of which penetrate the outer layers of uterine muscle and finally terminate as delicate twigs in the uterine mucosa, while others extend across the uterus and fusing with similar branches from the opposite side form direct arterial communications. From the latter, branches are given off which also penetrate the deeper-lying musculature and terminate in the mucosa. Beyond establishing the fact that there are direct arterial communications besides the usual capillary anastomosis and verifying the main points in the vascular scheme as depicted by others, I have not attempted to go, contenting myself for the present with a macroscopic study of the gross specimens and with the examination by means of a dissecting lens of thick sections cleared in xylol.

I hope to make a further communication upon the exact scheme of the circulation of the uterus at a future date.

The Mechanical Disturbances in the Circulation in Cases of Myoma Uteri.

From my study of the circulatory changes in uteri, the seat of myomata, I am convinced that the increased menstrual flow and atypical hemorrhages which are so frequently associated with these cases are dependent solely upon mechanical conditions, which induce first, a congestion of the deeper-seated muscular and endometrial vessels and this in turn to an increase or prolongation of the menstrual flow, and second, an actual derangement or disorganization of the vascular systems of the endometrium and of the tumor itself, through which atypical hemorrhages occur, varying in degree from a slight inter-menstrual discharge to a loss of blood so great as to cause the most prostrating or even fatal anaemia.

First, as to the part played by mere venous stasis in the production of the increased menstrual flow.

In its natural history the uterus after puberty passes through its successive menstrual cycles with the attendant sanguineous flow. According to some observers this flow is due to an actual rupture of the capillaries of the endometrium, while others believe that it occurs through a simple diapedesis. The latter view is held by Dr. Cullen, who has reached this conclusion after an extensive study of the endometrium in all of its normal and pathological conditions. According to my own observations I see no reason to doubt this conclusion.

With this well-sustained theory before us as a working basis the explanation of the increased menstrual flow in cases of myoma uteri is comparatively easy. In their early growth these tumors appear as minute whitish bodies lying in the depths of the uterine muscle. In all of my injected specimens, the smallest tumors, some of them not larger than a pea, show a remarkably poor internal vascularization, in comparison with

the surrounding musculature. The tumor apparently starts as a whirl or kink in the fibres of the muscle, and is not, according to my observations, supplied by a central vessel, as stated by some writers, but derives its blood-supply from vessels coursing between the surrounding fibres. This insignificant initial wreath grows into a thick network of encircling vessels which send radiating branches into the interior of the tumor. In the progressive development of the tumor the increase in the blood-supply is not commensurate with that of the tumor, which leaves its center sooner or later more or less isolated from the peripheral source. With the increasing size of the tumor, it follows the simple mechanical law of pushing in the line of least resistance, and accordingly tends to move outward towards the peritoneun, or inward towards the uterine cavity. In case the surrounding resistance is uniform it naturally maintains its intramural position. *Pari passu* with the outward mobilization of the tumor the tendency to a disturbance of the circulation sufficient to create menstrual disorders decreases. Even when the tumor remains as a simple interstitial growth no subjective symptoms relative to the menses are, as a rule, noted. There are, however, some instances where, notwithstanding the fact that the tumor does not encroach upon the mucosa, the menstrual flow may be increased or prolonged, but, so far as my observations go, never to the extent of becoming irregular and profuse. This condition, I am convinced, may be explained upon a mechanical basis. In the quiescent state of the uterus during the inter-menstrual period, the vascular system around the interstitial tumor is only partially filled; but let this same system become distended to turgescence under the menstrual influence, and it goes without saying that the force exerted by the congested and contracting uterine walls against the more or less dense fibro-muscular tumor, which remains practically unchanged in its resistance, will retard the exit flow from the deeper veins lying in proximity to the uterine mucosa. As a result of this venous stasis, increased extravasation or diapedesis of blood occurs into the uterine cavity. If there is a multi-nodular conglomeration of tumors the crowding together of these resistant bodies may also tend very greatly to inhibit the recurrent flow between them, producing even a greater internal congestion than in the first instance.

Here, just as in other tissues, the arteries, on account of the greater thickness of their elastic walls and their constant pulsations, tend to overcome the surrounding pressure and maintain their patulous condition, whereas the veins, which are in many instances little less than flaccid venous channels, are subject to compression upon the resistant tumors. A simple mechanical reproduction of this condition may be made by grasping in the palm of the hand a hard ball over which is placed a soft rubber tube with water flowing through it. A light pressure, sufficient to retain the ball in the hand, will not retard the flow through the tube, but a stronger grasp at once partially or completely checks the flow. In the application of this mechanical principle to cases of myomata, two sets of tubes coursing over the hard ball represented by the tumor must be considered, one of which, the arteries, as already stated, are elastic and pulsating, while the other, the veins, are mere passive channels. In the increasing congestion of the uterus incident to the menstrual cycle, the arteries tend to resist the surrounding pressure and maintain their flow, whereas the veins may become compressed against the tumor, and as a result a venous stasis in the deeper-lying tissue of the uterus occurs with a consequent increase and prolongation of the menstrual flux.

With the passing of the menstrual cycle the arteries return to a passive condition when the veins again become sufficiently patulous to transmit the blood to the large efferent trunks, and the metrostaxis ceases only to be renewed again in the succeeding period as a prolonged but otherwise normal flow. To prevent misconception as to the frequency of this occurrence I would especially emphasize the clinical fact, that in the majority of cases of interstitial and subperitoneal tumors, even increased menstruation does not occur, which is explained no doubt upon the ground of a compensatory vascular adaptability.

While the blood-vessels in close proximity to the tumor may partially be blocked the anastomoses within the uterus are so perfect as to leave patulous many other equally easy avenues of escape for the venous blood. Therefore, even a decided increase, without further derangement in the menstrual flow, is nearer an exception than a rule, unless there is some impingement of the interstitial tumor upon the endometrium.

With the encroachment, however, of the tumor upon the uterine cavity a second and most weighty cause for the hemorrhage comes into action. As depicted in the normal scheme of the uterine circulation the vessels which supply the endometrium reach this point by penetrating the inner muscular coat of the uterus, where they freely anastomose with each other and finally terminate as delicate twigs surrounding the glands of the mucosa. Until this scheme is very much deranged or disorganized by the advancing myoma usually no serious disturbance in the menses, as stated above, will occur. When the tumor, however, reaches the mucosa the menses tend to become free and prolonged, due to a thinning of the mucosa and a coincident degeneration of the vessels which renders the usual diapedesis much easier or gives rise to an escape of blood through actual rupture of the capillaries. In this connection I may say that, according to the histological observations of my colleague, Dr. Cullen, the vessels of the endometrium are very resistant, and that in the earlier stage of encroachment of the tumor the increased flow occurs by diapedesis rather than by actual rupture. At first only the terminal twigs of the endometrium are involved, but later, as the tumor advances and the tension is increased the mucosa through gradual erosion assumes a white, glazed, parchment-like appearance, showing the deeper-lying vessels of the capsule of the myoma.

At this stage the mucosa may be said to have disappeared from the dome-like prominence of the tumor; but further back towards the base where the tension is less and the process of erosion has not occurred, a vascular halo, formed by the vessels of the mucosa, is usually seen. Often a cup-like depression is made by the advancing tumor in the opposite uterine wall in which one finds the vessels exposed in a similar way. From this endometrial zone I have seen occur in some

of my injection experiments the most active oozing. In the further expulsion of the tumor the vessels undergo actual necrosis along with the tumor, which renders them brittle and more liable to hemorrhage through extensive ruptures.

The ocurrence of large irregular inter-menstrual hemorrhages may be taken therefore as an almost invariable indication of the development of a more or less extensive submucous tumor. When the tumor has reached the point where its overlying mucosa has entirely disappeared the hemorrhage may become well-nigh constant, appearing as a continuous oozing, which is especially aggravated during the menstrual epoch. Should the case be allowed to follow its own course without operative intervention, the tumor may be expelled completely with subsequent restoration of the patient to health, or it may become the seat of an infection which terminates the patient's life; or finally through the profound anaemia produced by the hemorrhage death may occur either through exhaustion or from a terminal infection.

Analysis of the Clinical and Pathological Records of 100 Cases.

In order to verify and further sustain the conclusions drawn from my experimental study, to ascertain whether there are frequent or wide variations from them, I have analyzed as closely as possible the clinical and pathological reports of 100 other cases. The clinical symptoms were taken largely from abstracts made by Dr. Brown from cases operated upon in the Gynecological Department of the Johns Hopkins Hospital, while the pathological reports were abstracted from records largely made by Drs. Cullen and Herdon. Excepting those atypical cases of myoma, such as the adeno-myoma-diffusum benignum (Cullen) and those in which there is a coincident infection, from ordinary pyogenic organisms or from tubercle bacilli or where there exists a coincident association with carcinoma, I have found a surprisingly small variation. For purposes of analysis I have first tabulated the clinical symptoms after which the pathological reports have been appended. As these tables are too voluminous for publication I have endeavored to embody the results of this analysis in the form of schematized drawings, hoping in this way to make these statistics more available for study than were they brought together in the ordinary tabulated form.

Of the hundred cases, I have first classified those which conform to the simple types of tumors (subperitoneal, interstitial and submucous), but as these comprise only about one-third of the total number, the remaining showing combinations of the three, I have placed them under the two following headings: Combined interstitial and subperitoneal, and combined interstitial and submucous tumors. In the latter group several cases have also presented subperitoneal tumors, but as they practically play no part in the production of hemorrhage I have grouped them all under the one heading.

Schematic Drawings of 100 Cases of Myoma Uteri.

(See Plates.)

This analysis shows beyond doubt that the clinical statement concerning hemorrhage in myoma uteri made by some authors is based upon accurate observations.

Dudley,* of Chicago, has stated this in such a concise and clear way that I take pleasure in quoting it. He says: "The degree of hemorrhage depends upon the location of the tumors relative to the endometrium and the peritoneum.

The closer its relations to the uterine mucosa, the greater the hemorrhage; the nearer to the peritoneum the less the hemorrhage; hence menorrhagia is almost invariable with the submucous variety, less severe but very common with the intramural, and usually slight or absent with the subperitoneal.

The pedunculated submucous and the pedunculated subperitoneal myomata stand at the two extremes, the former producing the greater hemorrhage, the latter none at all."

The Surgical Aspect of this Study.

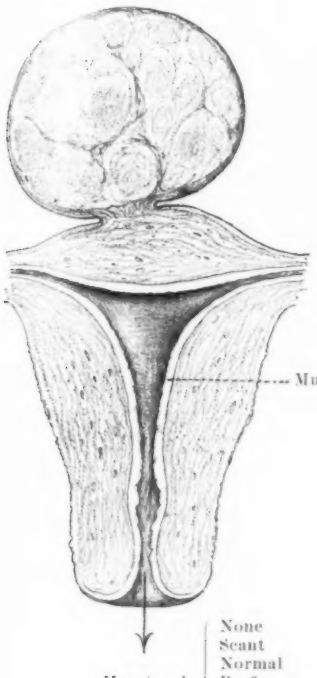
In criticism of the remarks following the appended reports of cases it may be said that an ante-operative judgment sufficient to render definite advice, as to the adoption of a radical or conservative line of treatment, is not possible, because data sufficient to support such a judgment cannot be obtained from the anamnesis or from our usual methods of examination. Admitting that this to a certain extent is true, I am nevertheless convinced that the close study of the symptoms in conjunction with a careful examination of these cases will usually yield very definite or at least strongly significant suggestions which will lead to a more complete diagnosis than is usually made.

The simple diagnosis of a myomatous tumor of the uterus with a subsequent hysterectomy is no longer a difficult matter, but the careful exclusion of the large number of cases from the great general class which, until the last two or three years, have been subjected to the wholesale extirpation of the uterus is a matter requiring accurate discrimination and good surgical judgment. Besides the superior judgment required for the selection of these cases, higher operative measures are brought into play, for it certainly requires more skill to remove the many tumors which one so often finds studding over the surface of the uterus, distending its walls or projecting into its cavity, and to repair through a plastic operation the resultant defects, than to perform a simple hysterectomy. The immediate results and splendid progress of these cases subsequent to operation are the strongest arguments in favor of conservatism.

The removal of either ovaries or uterus in young women, in the majority of whom the maternal instincts are more or less strongly implanted, is to my mind one of the most serious surgical procedures, and always to be avoided when possible, not because of the direct influence exercised by the presence of these organs on the womanly characteristics, but because of the depressing mental influences which follow in some instances the realization by the patient that she is sterile and will remain so to the end of her life. To say, therefore, that a simple or multiple myomectomy with the preservation of the ovaries and tubes is a great improvement over total hystero-salpingo-oophorectomy is not a subject for argument. It is a self-evident truth based upon the principle of preservation,

* Diseases of Women, 1898.

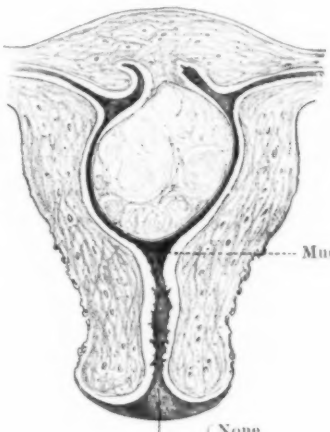
6. Subperitoneal.



Mucosa — Normal 4; Thickened 2; Atrophied 0

Menstrual Flow — None 1; Scant 2; Normal 3; Profuse 0; Irreg. and Profuse 0; Continuous 0; Painful: No 6; Yes 0

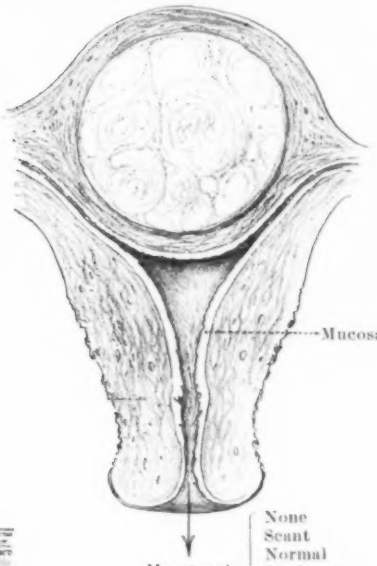
4. Submucous.



Mucosa — Normal 0; Thickened 0; Atrophied 4

Menstrual Flow — None 0; Scant 0; Normal 0; Profuse 0; Irreg. and Profuse 3; Continuous 1; Painful: No 3; Yes 1

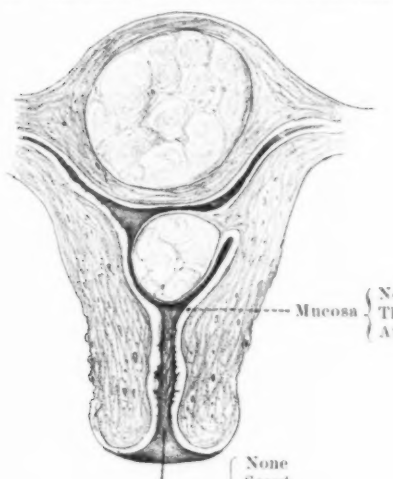
21. Interstitial.



Mucosa — Normal 9; Thickened 4; Localized 0; Atrophied 8

Menstrual Flow — None 1; Scant 1; Normal 11; Profuse 5; Irreg. and Profuse 3; Continuous 0; Painful: No 8; Yes 9

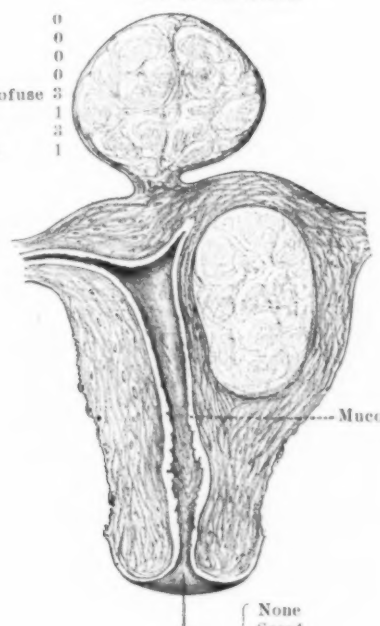
27. Combined Interstitial and Submucous.



Mucosa — Normal 1; Thickened 1; Atrophied 25

Menstrual Flow — None 0; Scant 0; Normal 4; Profuse 10; Irreg. and Profuse 10; Continuous 3; Painful: No 9; Yes 14

42. Combined Subperitoneal and Interstitial.



Mucosa — Normal 20; Thickened 10; Atrophied 12

Menstrual Flow — None 2; Scant 4; Normal 22; Profuse 9; Irreg. and Profuse 4; Continuous 1; Painful: No 21; Yes 18

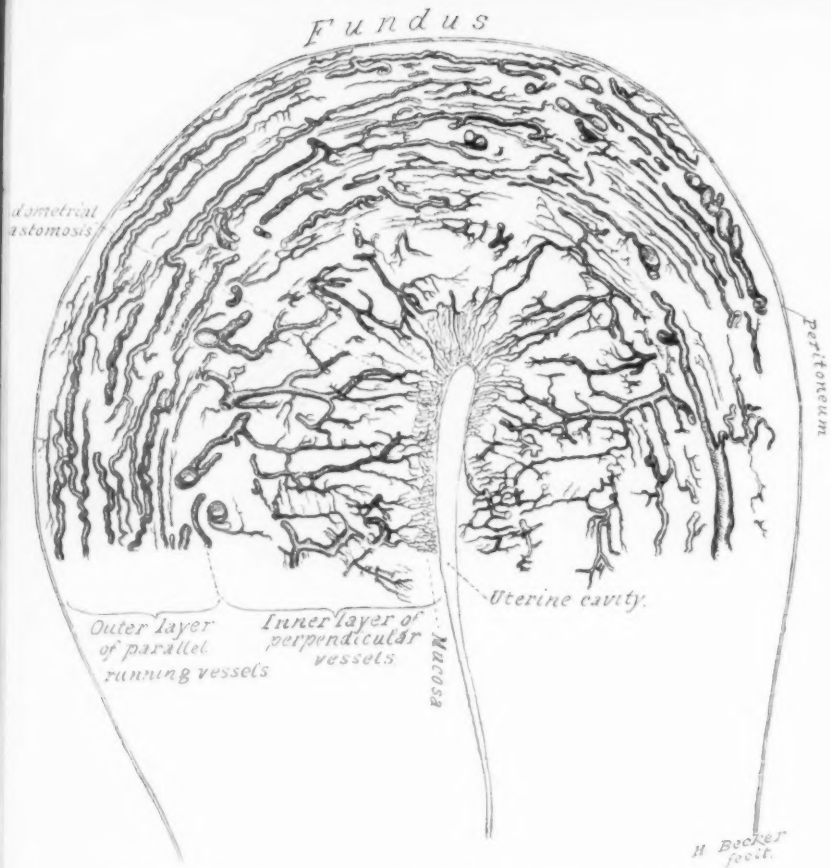


Fig. 1.—Sagittal section of uterus showing the scheme of the arterial distribution. The parallel vessels of the external muscular layer freely anastomose among themselves. From the innermost arteries branches are given off at right angles which penetrate the inner muscular layer, supplying it with numerous anastomosing nutrient vessels, and finally terminate in a rich capillary supply to the endometrium.

Fig. 2.—Injected specimen of interstitial myoma, showing derangement of vascular scheme. The perpendicular vessels noted in the normal scheme have here assumed a parallel course through the encroachment of the myomatous tumor. The endometrial twigs, instead of being merely the straight terminals of the perpendicular branches, are here given off at right angles. During the menstrual congestion these twigs naturally become more congested, through purely mechanical conditions, than in the normal state, consequently an increased diapedesis occurs. The large venous channels upon the surface of the myoma, to which attention has been called in the text, are also well shown.

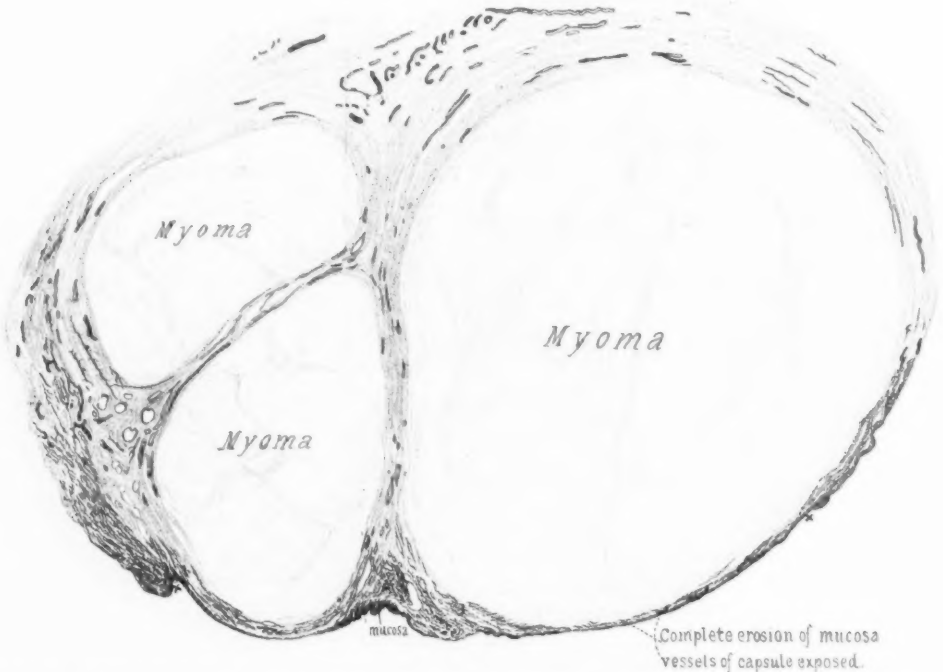


Fig. 3.—Uterine wall containing three interstitial myomata, two of which have so far encroached upon the uterine cavity as to cause almost complete erosion over the larger and considerable atrophy of the mucosa over the smaller tumor. The mucosa in the depression between the tumors is greatly thickened, œdematous and congested. Limit of mucosa indicated on either side by ×. In this instance the influx of blood being only slightly impeded and the reflux very greatly retarded by the crowding together of the three tumors the hemorrhage was excessive and irregular. The mucosa over the large tumor was so far eroded as to leave the wreath of vessels around the tumor exposed and subject to rupture either through simple pathological or traumatic influences.

rather than that of sacrifice, which in the end leads to a restoration rather than an abrogation of function. I feel assured when the combined statistics of the best surgeons of the world have been brought together after the general adoption of these revived principles, that those on conservative myomectomy will present a much more gratifying result than those on total hysterectomy.

A Brief Reference to the Literature Bearing Upon the Etiology of Hemorrhage in Cases of Myoma Uteri.

The almost unlimited and unclassified literature dealing with the subject of myoma uteri in its various aspects renders well nigh impossible a selection of the special work upon this topic. For this reason, therefore, I must disclaim the thought that this is an exhaustive review, for I have only attempted to give a brief abstract from those investigations which are generally quoted, with the view of calling attention to the most interesting and instructive points previously brought out in this line.

Wyder,* whose conclusions were drawn from the study of 20 cases, attributed the hemorrhage to endometritis, induced through the presence of the tumor. According to him the thicker the muscle which separates the myoma from the uterine cavity the less frequently will the circulation be changed and the more pronounced becomes the growth of the uterine glands without participation of the interglandular connective tissue. On the other hand, the nearer the tumor approaches the uterine cavity the more frequently occurs the growth of the interglandular connective tissue, which may leave the glands intact or induce complete atrophy.

Concerning the hemorrhage, he says so long as the endometritis which, according to his opinion, is a constant accompaniment of these tumors, is confined solely to the glands and the interglandular tissue remains approximately normal, this symptom will not occur, and it will only arise when both constituents of the endometrium undergo an increase (Olshausen's endometritis fungosa), or when the one or the other grows excessively, or finally when in addition to the endometritis glandularis there is also an interstitial inflammation.

As is at once evident, Wyder's views are not tenable, for, as stated by Semb,† the tumor cannot of itself induce an inflammatory process in the endometrium.

In the examination of 23 cases in Leopold's clinics Semb found in many instances absolutely no evidence of endometritis, and in those cases in which an inflammatory process occurred he considered it merely as secondary to the tumor. From his histological examination he concludes that the mucosa undergoes hypertrophy, without preceding inflammation, consisting either of a uniform increase in both the stroma and the glands or the glandular changes may predominate. After reviewing each of his cases he says hemorrhage will not arise, notwithstanding the most marked changes in the endometrium, or increase in the size of the tumor, if the walls of the tumor show no hypertrophy. According to this view therefore the hemorrhage depends upon hypertrophy of the uterine musculature with accompanying pathological changes in the vessels.

Schmal * arrived at the following conclusions concerning the changes in the uterine mucosa from the study of 15 cases: First, in subserous myomata the mucosa may remain normal or become hypertrophied. Second, in interstitial submucous tumors the mucous membrane becomes atrophic over the tumor and hypertrophic opposite the tumor. No opinion is expressed concerning the occurrence of hemorrhage in these cases.

Borissoff,† from a study of 21 cases of fibro-myomata, reached the following conclusions:

1. In fibro-myomata the mucosa shows a pronounced sclerosis, which in many cases induces a complete atrophy of the mucosa.

2. Glandular endometritis is relatively seldom observed. It occurs more often in combination with interstitial endometritis.

3. The influence of the tumor upon the mucosa depends entirely upon its position in the uterine wall and its size. If the tumor has reached a certain size it induces through mechanical influence a stretching and atrophy of the mucosa.

4. Bleeding from the uterine cavity results from stagnation of blood in the mucosa and occurs mostly *per rhexin* of the vessels which have undergone pathological changes.

5. The inflammatory changes in the mucosa with the congestion and hemorrhage lead to a desquamation of the epithelium.

Schauta,‡ at a more recent date, states in his text-book that hemorrhage seldom occurs from the myoma or its capsule; erosions of the covering layers of the tumor may, however, lead rapidly to fatal bleeding from the large sinuses. Changes in the mucous membrane play the principal rôle; of these hypertrophy takes a much less part than the degeneration of the mucosa and its vessels. This degeneration consists in a thinning, necrosis and erosion of the tense mucosa over the tumor as well as changes in the blood-vessels, which lead to the occlusion of some, to the widening of others and to the rendering of the loops of the vessels brittle.

To my mind this is the best concise statement of the subject which I have found, and conforms in general, as do the conclusions of Borissoff, with those which I have reached.

Cases Illustrating Mechanical Disturbances in the Circulation in Cases of Myoma Uteri.

A brief clinical report of the cases with the description of the injection experiments of the principal types of tumors will, I believe, be of more service in explaining the hemorrhages in these cases than the mere recital of results. I therefore offer no apology for inserting the following report of cases. For the sake of brevity I have reduced my notes to merely the essential points bearing upon the question, divest-

* Archiv f. Gynaek., Bd. XXIX.
† Archiv f. Gynaek., Bd. XLIII.

* Archiv de Tocologie et de Gynécologie, Tome XVIII.
† Inaug. Dis.: "Ueber die Veränderung der Uterus-Schleimhaut bei Fibromyomen in Verbindung mit Uterusblutungen," St. Petersburg.
‡ Lehrbuch der Gesammten Gynäkologie, 1896.

ing them so far as possible of irrelevant and unnecessary matter.

CASE I. *Menstrual history.*—Menses occurred first at 14 years, regular, accompanied by cramp-like pains, moderate flow, occasionally dark clotted.

Description of specimen.—Uterus converted into a smooth globular mass about the size of that of a three-months pregnant. The surface of the uterus is even and its general form has not undergone very much distortion, notwithstanding the presence of numerous interstitial nodules, which may be felt within the uterine walls. Posteriorly at the cervico-fundal juncture an interstitial tumor has pushed out towards the periphery and appears as a partial subperitoneal growth.

Injection.—Fluid carmine and granular blue injection mass. Cannulæ inserted into each ovarian and each uterine artery, the ovaries remaining attached to the tumor.

Injection began in the left uterine artery, when almost immediately the fluid imparted a deep red color to the uterine wall of that side; hardly had this occurred before the mass quickly passed through the uterus at the cervico-fundal juncture and began to flow from both the uterine artery and vein, followed quickly by its escape from the two ovarian vessels, necessitating the clamping of all of them. From this one vessel the entire uterus and Fallopian tubes were injected.

At the completion of the injection from this source, notwithstanding the apparent complete filling of all the vessels of the uterus, each of the three remaining arteries (one uterine and two ovarian) was in turn injected with a blue granular mass, when the same phenomena were repeated so far as the distribution of the injection fluid was concerned. By this time a very small amount of the red gelatine mass was flowing from the cervix, partly from the uterine cavity, mostly however from the severed ends of the small cervical vessels.

Examination of specimen.—On section through the uterus in the median line, from the fundus to the cervix, a most interesting picture is presented.

The uterine muscle is of a uniform red color, mottled with many blue points, indicating the branches of the arterial system. In the midst of this deep red ground color numerous paler myomatous nodules are seen, representing the various clinical varieties of these tumors. One interstitial tumor lies in close proximity to the mucosa. In color the myomata stand out in sharp contrast to the uterine wall, for they are universally poorly injected, the degree of vascularization however varying in the different tumors, some appearing of an alabaster-like whiteness and so poorly supplied with blood as to raise the question of how their existence is possible with so little nutrition. Others, however, are better provided with a vascular system. Of these one is especially interesting, for it is made up of two whirls of muscular tissue with a distinct septum between them carrying blood-vessels which send branches off into the adjacent nodules. Every nodule in the uterus appears well surrounded with vessels consisting in some instances of large open-mouthed channels which appear little less than venous sinuses. The peripheral nodules show a marked thinning out of the zone of vessels beneath the peritoneum, the main blood-supply coming from the vessels deeper within the walls of the uterus. The endometrium is deeply injected with the red gelatine, while numerous blue puncta are seen over the surface, indicating the terminal points of the arterial twigs.

A thin delicate film of red gelatine is spread uniformly over the mucosa, which has evidently oozed from the vessels of the endometrium. So far as visible pathological changes are concerned the endometrium presents nothing significant, being of normal thickness and consistence throughout the uterus, the interstitial nodule not yet having advanced a sufficient distance into the uterus to cause any visible changes.

Epitome of observations.—Universal injection of the uterus and tubes from one uterine artery; rich vascularization around and poor vascularization within the tumors; absence of extensive oozing into the uterine cavity, notwithstanding the presence of many intramural myomata; absence of gross pathological changes within the endometrium.

CASE II. *Menstrual history.*—Patient is a colored woman of rather low intelligence and gives an indefinite history of her menstrual symptoms up to a few months ago, when the flow became profuse. Lately the hemorrhages have become excessive, reducing the patient to a very anæmic condition.

Description of specimen.—The uterus has been converted into an irregular tumor mass through which it has become so distorted that it no longer maintains any semblance to its normal form or size.

The main body of the uterus is very greatly enlarged and is studded over with subperitoneal tumors.

Upon the middle of the fundus a tumor the size of a fœtal head is attached by a thick fleshy flat pedicle. The surface of the tumor is of a dull grayish-white color, and shimmering through the peritoneal covering are yellowish necrotic-looking areas. On the left lateral wall there is a nodule about the size of a hen egg, which has undergone calcareous change.

Injection.—Carmine red and granular blue gelatine injection mass.

The left uterine artery was taken as the initial injection point, from which the entire left side became faintly red and then gradually spread upward through the fleshy pedicle of the large tumor and partially injected the peripheral areas.

Very soon after the beginning of the injection the fluid gelatine began to flow from the opposite ovarian vessels.

While injecting the second uterine vessel the fluid began to flow from the cervical canal in a large stream, showing that there must be extensive oozing within the cavity.

The ovarian vessels were injected in turn, at the completion of which the main body of the uterus and the base of the subperitoneal nodules were of a deep red color, but approaching the outer poles of the tumors the injection became fainter and fainter, until in some of them, especially the large and the calcareous tumors, there appeared to be a complete occlusion or destruction of the vessels.

Examination of specimen.—On section of the uterus a large submucous myoma 5x4 cm. was found covered by a fine leash of extremely thin-walled vessels varying from the size of capillaries to furrowed sinuses as large as a goose quill.

Numerous ruptures had occurred in these vessels as evidenced by the many areas where large exudations of fluid had occurred over the surface and by the large coagulated mass which filled the uterine cavity like a cast.

The endometrium appeared normal or hypertrophied, except over the tumor, where complete erosion had occurred, leaving exposed the capsule of the tumor with greatly dilated and thin-walled vessels running over its surface. On section the interstitial nodules presented the same appearances and poor vascular supply as noted in the preceding case.

The submucous and subperitoneal tumors show a marked variation in their vascular systems, due to the mobilization of the tumors from the interior to the surface of the uterus. In every instance the wreath-like arrangement has been destroyed, and the blood supply is obtained through the vessels traversing the pedicle or base of the tumors.

The center of the large subperitoneal tumor has undergone almost complete necrosis and consists of a cavity filled with a soft yellowish-white pulpy detritus, while one of the other nodules above noted has become calcified.

The center of the large submucous tumor is also of a very soft yielding brain-like consistence.

Epitome of observations.—Injection of well-nigh entire tumor mass from one uterine artery; full vascularization around but very poor within interstitial tumors; great failure in blood supply of subperitoneal tumors as a result of which one has undergone necrosis, the other calcification; complete disappearance of endometrium over submucous tumor and contiguous areas of the uterine wall; exposure of large sinuses within the capsule of the submucous tumor, with rupture of these sinuses and other smaller vessels; beginning degeneration of submucous tumor through failure of internal blood supply.

Remarks.—This specimen presents an interesting phase in the life history of myoma uteri, for it undoubtedly represents a stage in which the hemorrhage has reached its height.

Had this case been allowed to take its own course without the intervention of surgical measures, the subsequent history would no doubt have been marked either by death from acute anæmia or from a terminal infection, or by a complete extrusion of the submucous tumor, with a final cessation of the hemorrhage, for in this specimen there was no other interstitial tumor impinging upon the uterine mucosa, on the contrary they were all in process of mobilization towards the peritoneal surface.

The large subperitoneal tumor was already in an advanced stage of necrosis, and it is possible to conceive that notwithstanding the number and size of the tumors, a gradual decrease in size by slow absorption with final cessation of all threatening symptoms might have occurred.

In the days when these tumors were never operated upon, instances are recorded of large tumors disappearing which were no doubt of this character. It is of course a *reductio ad absurdum* to assume that the stone-like tumor would ever have disappeared through any disintegrating process, but it is not contrary to the natural history of these and of cases of lithopedion for calcified masses to remain *in situ* throughout the natural life of their hostess without inducing serious consequences.

These remarks are simply incidental and bear purely upon the supposititious terminations of such cases as these, and they are in no sense intended as suggestions for conservatism in their treatment. On the contrary, my views are radically in favor of nothing less than a total hysterectomy.

Even assuming that this post-operative knowledge might have been in the surgeon's possession at the time of operation, no other course than that pursued would have been advisable, for while the case might have terminated favorably under a conservative policy the dangers of a fatal hemorrhage, of a long drawn out illness from prolonged necrosis or from suppuration of the submucous tumor, of a rapidly lethal terminal infection, or of many other immediate or remote complications would have so far overshadowed this result as to make it extremely bad surgery to do less than perform a hysterectomy.

CASE III. *Menstrual history.*—Menses occurred first at 14 years, regular, accompanied by considerable pain; since onset of present disease the flow has been thinner and is more watery than usual.

Description of specimen.—Irregular multinodular myoma measuring 15 x 10 cm. in size. The uterus is so distended by the irregular growth and distribution of the tumors that it has lost all appearance of its original shape. The base of the uterus where it has been amputated is irregular and the uterine arteries stand out prominently as large patulous tubes. Two interstitial tumors have well-nigh reached the stage in their mobilization towards the peritoneal surface where they may be designated as purely subperitoneal. On palpation of the mass two or three large interstitial tumors may be outlined.

Injection.—Granular blue and red injection mass. The same phenomena were observed in the topographical distribution of color as in the foregoing experiments. On applying increased pressure to the injecting apparatus towards the close of the experiment the gelatine was seen flowing from the uterine cavity as a thin, delicate film.

Examination of specimen.—On section the uterine wall was found to be occupied by two large interstitial and three partially subperitoneal tumors. The uterine cavity was somewhat tortuous, distorted and considerably lengthened. The mucosa was of a uniform deep red, dotted over with numerous blue puncta, indicating the terminal points of the arterial branches. The thickness and consistency of the mucosa, so far as macroscopical appearances were concerned, were normal, and in only one area on the lateral wall of the fundus was there any encroachment of the interstitial tumors upon the cavity, and even here the small nodule, although projecting as a hillock into the fundus, had as yet induced no mechanical changes in the endometrium. The partially subperitoneal tumors are as yet well provided with a peripheral wreath of vessels, although the substance is of an alabaster-like whiteness.

Epitome of observations.—Usual circulatory phenomena resulting from the injection of one artery; tumors all interstitial, some moving toward the peritoneum while one small one tends to become submucous; mucosa intact, no mechanical changes.

Remarks.—In this case the patient entered the Hospital suffering from the effects of chronic salpingitis and peri-ōophoritis, the lateral structures being intensely adherent and extensively diseased. The operation of total extirpation was therefore

indicated, not for the relief of the myomatous condition, but for the lateral disease. Given such a case as this, without any coincident disease of the appendages, the proper treatment should be absolutely conservative, for there is no immediate indication for operation. Should, however, the menses become too profuse or irregular a simple curettage would suffice to relieve the symptom, for we see that at this stage of growth there is but the one small tumor tending to become submucous, while the others push out towards the peritoneum. Such cases as these may go on to the formation of multinodular pedunculated submucous tumors, which sooner or later undergo softening and expulsion, after which all uncomfortable symptoms cease.

CASE IV. *Menstrual history.*—Flow began at 16 years, at first monthly, but during the last six years her periods have been two months apart. Flow continues one week, then ceases for 1½ days to return for 2 or 3 days. Flow is scant and accompanied by pain. Last period May 2d. Operation May 9th.

Description of specimen.—Globular myoma, measuring 15x10 cm., occupying the posterior wall of the uterus.

Injection.—Carmine gelatine. At the completion of the injection the red gelatine was escaping in a small filmy stream from the cervix.

Examination of specimen.—On section the tumor presented on first sight all of the appearances of the submucous variety, but on closer inspection was found to be entirely interstitial, for although projecting very greatly into the uterine cavity it was nevertheless surrounded entirely by the uterine musculature, which averaged 1 cm. in thickness. The mucosa was not perceptibly thinned out. The tumor itself, contrary to the usual rule, was extremely vascular, being penetrated by many large dilated vessels.

In the uterine tissue between the myoma and the mucosa there were many large vessels, which in the mobilization of the tumor had been pushed ahead of it. The tumor projected 6 cm. into the uterine cavity, having originated in the fundal portion and grown downward into the cavity, distending it quite equably on all sides. The endometrium was intact and showed no thinning at any point, except at the apex of the tumor, where it was slightly atrophic.

Epitome of observations.—Single large interstitial globular tumors which, so far as morphology was concerned, presented at first sight the appearance of a submucous tumor. Marked exception to the rule on account of extreme vascularity of tumor. Little or no atrophy of mucosa. No excessive bleeding, on the contrary decrease in the frequency of the menstrual periods.

Remarks.—This is one of the most interesting cases in my entire collection, because it illustrates so well the purely mechanical principles governing the deviation of the menses from the normal flow. Here, notwithstanding the excessive vascularity of the tumor and the uterine wall, the patient had suffered from absolutely no excess in her menstrual bleeding. The study of the specimen at once shows that the two essentials for hemorrhage, first, the erosion of the mucosa and second the retardation or stagnation of the blood currents through the mechanical conditions induced by the tumor, are absent, consequently no hemorrhage had occurred. The second point to which I would draw attention are the possibilities in the line of operation. Although this tumor was quite large and had caused wide distention of the uterine wall and extensive distortion of the uterine cavity, a simple myomectomy could nevertheless have been performed, leaving to this woman, who was only 36 years of age, a uterus which might sooner or later have been sufficiently restored to its normal shape and condition as to be capable of bearing a child. A simple myomectomy is now invariably performed upon such cases in the gynecological clinic of the Johns Hopkins Hospital without even the thought of resorting to hysterectomy.

CASE V. *Menstrual history.*—Menses at 13; as a rule regular, painless, duration 5 to 7 days. Of late the flow has grown more profuse, but is still regular.

Description of specimen.—Large globular uterus 6x16 cm. in size with densely adherent and mutilated left ovary and tube. The consistency of the tumor is soft, doughy and plastic, and can be moulded into any shape.

The main development of the tumor is in the posterior wall of the uterus and partakes of the characteristics of both the submucous and subperitoneal types on account of its growth towards the peritoneal and uterine cavities.

Injection.—Carmine gelatine. Points of injection, the left uterine and right ovarian vessels. The first point injected was the uterine vessel from which the left lower segment was first colored red, then the left cornu and middle portion, following which the injection mass rapidly spread over the entire uterus, imparting a brilliant carmine red color to it.

To insure the fullest distention of the vessels, notwithstanding the apparent perfect injection of the entire circulatory system, fluid was forced into the right ovarian vessel. During the course of the injection the red gelatine, as in other preceding experiments, began to escape from the cervical canal.

Examination of specimen.—On opening the uterus the tumor was found to be a large interstitial one, undergoing necrosis. The peritoneal covering and capsule of the myoma showed a uniform intense red and blue injection, but at the point where it presented towards the uterine cavity was especially rich in vessels. The uterine cavity was considerably lengthened but not distorted. The endometrium was of a deep carmine color with numerous blue points appearing quite uniformly over its surface. The tumor itself was necrotic, its center consisting of a soft pulpy mass. The study of the injected fields in connection with the necrotic process is interesting, but offers no novel observation. As would be expected, the areas in which the circulation has been retarded, or has ceased altogether, are the ones undergoing necrosis.

The posterior portion of the tumor, next to the uterine cavity, is poorly vascularized, but near the apex two muscular whirls are still preserved which contain a few injected vessels. The central necrotic area shows no trace of blood-vessels.

The capsule of the tumor at its apex is one-half cm., in the anterior wall 2 cm., between the uterine cornu 1 cm., and opposite the uterine cavity 1 cm. in thickness.

The uterine mucosa is intact and at no point is attenuated.

In this case the vessels of the capsule between the mucosa and uterine cavity were quite large and dilated.

Epitome of observations.—Large intramural myoma undergoing necrosis, vascular system within tumor almost completely destroyed, no involvement of uterine mucosa. Menstrual bleeding increased but no inter-menstrual flow.

Remarks.—In such a case as this the question naturally arises, What are the chances for final absorption of the tumor? With such a rich vascular supply around the tumor and its isolation from the uterine cavity the probabilities are that in time it would have entirely disappeared. The retrogressive changes, however, might have been slow, and the symptoms attending the absorptive process so unpleasant that we cannot consider this a case for conservative treatment, especially in view of the fact that the woman was 42 years old at the time of her admission to the Hospital. This case is a good illustration of that type so frequently referred to in medical literature in which the tumor disappears at or about the menopause. That this occurrence, however, is not of sufficient certainty to be depended upon will be shown in the reports of cases from the Johns Hopkins Hospital, for according to our observations the menopause is quite likely to be much slower in appearing, and even then the tumor instead of decreasing may grow larger.

I can hardly think it possible in such a case as this to achieve much success with a conservative operation; on the contrary, I should consider it bad surgery to attempt to save a useless organ in a woman 42 years of age, especially if this attempt were to be attended with more danger than a simple hysterectomy.

CASE VI. *Menstrual history.*—Flow began at 14 years; regular until 3 years ago; since then irregular, occurring some months twice and then possibly not for two months or more. Flow not excessive, lasting 4 days.

Description of specimen.—The specimen consists of a myomatous uterus and the right ovary and tube. The uterus is irregular in shape, being distended in its right latero-posterior walls by a globular intramural myoma 4x4 cm. in size. With this exception the general form of the uterus is preserved, measuring 7 cm. in length by 8 cm. in greatest width. Length of uterine cavity 5 cm.

Tube and ovary have been densely adherent, and are more or less mutilated by the operation.

Injection.—Carmine and granular ultramarine blue gelatine. Only a very slight amount of the red fluid oozed from the uterine cavity during the injection.

Examination of specimen.—Section through the center of uterus shows the uterine cavity and the endometrium to be normal.

The myoma, which occupies one lateral wall, is strictly intramural and does not impinge upon the uterine mucosa. The tumor itself is sparsely vascularized, but has a very rich aggregation of vessels surrounding it.

Remarks.—In this case the indication for operation was the diseased condition of the ovaries and tubes, the myoma being merely a coincident complication.

In a case like this, unassociated with any pathological condition of the appendages, the line of treatment should be absolutely conservative, for a tumor of this nature gives no discomfort until it has increased very markedly in size. With a simple growth like this, in which there is no impingement upon the mucosa, no derangement of function as a rule occurs. The slight change in the periodicity of the menses noted in the menstrual history can be accounted for much more readily by the diseased condition of the appendage than through any influence exerted by the myoma.

CASE VII. *Menstrual history.* Until a few months ago flow has been profuse, but not irregular; since then it has, at times, been almost constant.

Description of specimen.—Specimen consists of a uterus very greatly distorted by three myomata, one 7x7 cm. in size, occupying the fundus; the other two (5x5x4 cm. in size) the lateral walls of the uterus.

Injection.—Carmine and granular blue gelatines. At the completion of the injection the red fluid was running from the uterus in quite a stream.

Examination of specimen.—Section through the nodule in the fundus shows it to be poorly vascularized while the surrounding uterine muscle presents a uniform red color with numerous blue points, indicating the position of the arteries. The tumor pushes down into the uterine cavity and is more than half submucous. The endometrium over the tumor has almost entirely disappeared, leaving the tumor towards its apex with a glazed whitish appearance and covered by thin-walled exposed vessels.

The mucosa is intact at the base of the tumor, but as it extends downward gradually becomes thinner and thinner until it reaches an equatorial zone or line of demarcation, where it is completely eroded and the vessels appear upon the surface. From the appearance of the vessels they are without doubt the original vessels which have surrounded the tumor in its intramural state, and with its mobilization towards the uterine cavity, have been pushed ahead of it. A small submucous tumor just below this one shows the same characteristics. A third submucous tumor springing from the lateral wall, through contact with the large tumor has been deeply indented. The mucosa of that portion of the uterine cavity not impinged upon by the submucous tumors appears considerably heaped up and thickened.

The two interstitial nodules show a moderately good injection, but not so intense as that of the surrounding uterine muscle.

Epitome of observations.—Large submucous tumor, the vessels of the capsule of which have become exposed by erosion and have given rise to profuse hemorrhage through rupture and diapedesis. Two interstitial tumors showing the typical wreath-like arrangement of their external vessels and a relatively poor internal vascularization.

Remarks.—This case shows best of all the mechanical basis for the excessive hemorrhage in advanced types of submucous myomata. Observations made in preceding cases taken in conjunction with the evident conclusions which may be drawn from the case in hand permits us with little doubt to outline the progress and the attendant symptoms of the submucous tumor distending the uterine cavity. At first it has originated as an interstitial tumor, with a rich peripheral blood supply like those which still occupy an intramural position, but

through a disturbance of the surrounding equilibrium, excited by the contraction of the uterine muscle, it has begun to move towards the uterine cavity, that being, in this particular instance, the line of least resistance.

In its progress it has carried its surrounding wreath of vessels until the endometrium has been reached, and this, through the excessive tension produced by the tumor, has become attenuated and finally eroded until the capsule of the tumor, with its large thin-walled vessels, were exposed.

As resultant symptoms of the mobilization of this tumor, there was first an increased menstrual flow, due simply to congestion and stasis, but later through attenuation of the endometrium and exposure of its vessels; this became excessive and finally when the large sinus-like vessels became exposed, any slight exertion, such as undue exercise, coitus, etc., would give rise to profuse inter-menstrual hemorrhages simply through excessive diapedesis and actual rupture of the vessels.

While the mucosa in the areas covering the myomata was undergoing erosion that of the remaining portion of the cavity was being heaped up and increased in thickness, not only by a mere mechanical crowding and sliding upon its muscular base, but also through an actual hypertrophy or through congestion and oedema.

It is needless to say that any course of treatment in this case short of hysterectomy would be questionable, for the excessive involvement and great increase in the volume of the uterus with the marked distortion of the cavity would leave little hope of preserving the organ, even in the hands of the most skilled plastic surgeon.

Case VIII.* *Menstrual history.*—No derangement of flow.

Description of specimen.—The uterus is converted into a large irregular mass 21x18 cm. in size, consisting of one large subperitoneal tumor measuring 5x6 cm., several small ones of the same variety, and numerous palpable interstitial tumors.

The large subperitoneal tumor has become pedunculated, and although the blood supply, carried through the thick, fleshy pedicle would appear to be sufficient to maintain the nutrition of the myoma, it has secured an additional source, having established an adventitious or parasitic communication with the vessels of the left ovary, from the inner pole of which a large congeries of vessels cross over through a bridge of adhesions and spread out upon the apex of the tumor.

Injection.—Liquid Prussian blue with cinnabar granules held in suspension by agitation. The left ovarian artery was first injected, the vessels of the broad ligament and the ovary first took the coloring matter, and then the fluid was seen to pass over the bridge of adhesions and penetrate the apex of the tumor. In the meantime the uterine branch of the ovarian artery had quickly carried the fluid to the uterus and almost simultaneously with the appearance in the tumor of the blue color from the adventitious vessels, it was also beginning to show itself in the pedicle and base of the tumor. About this time the cannula became blocked and the simple blue solution was then forced into the opposite ovarian artery, when the tumor and the remainder of the uterus assumed a deep blue color.

Examination of specimen.—On bisection of the tumor mass it was found that the large subperitoneal myoma, notwithstanding its adventitious and ordinary blood supplies, was undergoing necrosis, the center having already been converted into a pulpy mass. The other subperitoneal and two or more of the interstitial growths also showed a very poor vascularization.

The uterine cavity occupied a median position between the many tumors and, although distorted, at no point was there any invasion by the interstitial tumors.

The mucosa in general was thin but appeared perfectly normal with the exception of an area where a slight erosion had occurred.

At this spot evidences of a recent hemorrhage were seen.

Epitome of observation.—Subperitoneal myoma which, notwithstanding a second or adventitious blood supply had undergone necrosis. Little involvement of the endometrium. Tumors numerous, but all interstitial or subperitoneal.

Remarks.—This case represents the type of parasitic tumors which are by no means uncommon within the abdomen.

As a rule, the most common adventitious vascular source in such instances is the omentum. Frequently the nutrition of myomata, dermoid and simple ovarian cysts is greatly increased by the penetration of the growth with vessels from the omentum. Indeed it is not uncommon for tumors to maintain an existence even after a total severance from their original blood supply.

From our present operative standpoint in this case, only the radical operation could be advised, as it can readily be appreciated, that it admitted of no conservative treatment.

Note.—The reader's attention is called to a colored plate in Kelly's *Operative Gynecology*, Vol. II, p. 338, Plate XIX, drawn from a case in my series of injected specimens showing all the types of tumors. The relatively poor vascularization of the tumors stands in marked contrast to the deep carmine red of the uterine musculature. The main source of hemorrhage in the submucous variety is indicated by the vascular halo around the projecting tumor.

* On account of similarity to other cases in this report, Cases IX and X have been omitted.

A STUDY OF SIXTY-SEVEN CASES OF PRIMARY MALIGNANT TUMORS OF THE SUPRARENAL GLAND.

By Otto Ramsay, M. D., *Baltimore, Md. Resident Gynæcologist, The Johns Hopkins Hospital.*

Primary malignant tumors of the suprarenal gland are among the rarer forms of abdominal new-growths, and it is probably for this reason that so little attention has been paid to them in medical literature. Now, however, as sureness in diagnosis increases and as abdominal surgery is becoming daily more simple and less dangerous, it seems time that a more prominent place should be given them in the roster of abdominal tumors.

I have endeavored, as far as possible, to collect all the published cases, and from them and the three which I have seen personally, to draw some conclusions as to the symptoms, the prognosis and the possibilities of operative treatment. No attempt has been made to discuss at any length the etiology of these growths, as it would involve too much space and be merely a reiteration of views already published.

Many difficulties have been encountered in this task, chiefly due to the incompleteness of the reports, and I have not attempted to change the classification of the tumors and have tabulated them under the name by which they were described by the author, though I was struck with the number of carcinomata observed by the older writers as compared with those seen at the present time.

The first two cases were admitted to the Gynæcological Department of the Johns Hopkins Hospital, and were operated upon by Dr. Howard A. Kelly. The third case, which was operated upon in the Surgical Department, I owe to the courtesy of Dr. J. M. T. Finney.

CASE I.—*Globular Tumor in the Right Renal Region. Operation. Recovery.*

Mrs. C., white, age 53, was admitted to the Gynæcological Ward of the Johns Hopkins Hospital, Dec. 26, 1896, complaining of a tumor in the right side of the abdomen. Her family history was good.

She has had the usual diseases of childhood, but otherwise has always been a healthy woman. Eight years before a cystic tumor of the right breast was removed. She had always menstruated irregularly, the menopause occurring at the age of 50. In January, 1895, or just one year before the patient was admitted to the Hospital, she first noticed a small, hard, oblong mass in the right side of the abdomen, which has slowly increased in size up to the present time accompanied by continuous stinging pain in the right lower abdomen, which has been much more severe during the past three weeks. The abdomen has never been distended, and she has never had any jaundice. She has lost 20 pounds in the last three weeks, is thin and anæmic in appearance, and there is a very slight brownish discoloration of the skin in places. The patient has never noticed any discoloration of the urine by blood, and on several careful urinary examinations after her admission to the Hospital no blood could be detected. The bowels have always been constipated.

On examination, the right side of the abdomen is found to be the seat of a large globular tumor, which occupies chiefly the right hypochondriac, the right side of the epigastric, and the upper portion of the umbilical regions, and the right flank below the ribs is bulged out by this tumor. On respiration the skin is seen to move over the tumor, but there is no respiratory movement of the tumor itself. On palpation a globular mass is felt, occupying the right side of the abdomen and reaching to the middle line. Above, the border is not distinct, but a deep furrow separates it from the costal margin. The most prominent portion anteriorly is occupied by a hard, rounded ridge extending inward and slightly downward, the ridge being about 12 cm. in length and 4 cm. in breadth, the ends appearing gradually to merge into the tumor. The surface except for this ridge and several smaller rounded prominences is smooth. It is slightly movable towards the left to firm pressure but gives the feeling of a fixed tumor. The measurement from above downward is 6½ inches, the greatest diameter being oblique, from the external border downward and inward—this measurement being 7 inches. The percussion note over the tumor is only slightly tympanitic in quality, save over the lower inner portion, where tympanitic resonance is found.

The clinical diagnosis of a renal new-growth was made from the position of the tumor, the history of constant increase in its size, and in spite of blood never having been found in the urine. It must be stated that a tumor of the suprarenal capsule or other retroperitoneal growth in this situation was never for a moment considered, notwithstanding the presence of the rounded ridge, so like in shape and size to a kidney.

Operation.—An incision was made in the median line 12 cm. in length. On opening the abdominal cavity the tumor was found generally adherent and crossed on the lower portion by the colon; the prominent ridge above spoken of was found to be the right kidney displaced and lying in front of the tumor. The peritoneum was carefully stripped off on both sides, the operator working down towards the vessels lying under the tumor. The ureter was first recognized and cut between two ligatures. The tumor was then somewhat raised, and first the large renal vein and then the artery were caught and tied, these maneuvers being difficult because of the proximity of vena cava. An enlarged gland near the upper portion was removed with the tumor. After the tumor was removed a counter-opening was made in the lumbar region and a gauze drain inserted.

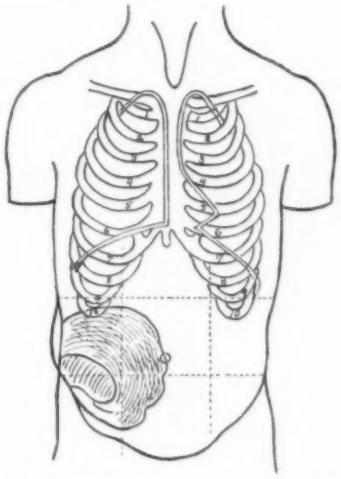


FIG. 1.—Shape and position of tumor. The rounded body indicated was the misplaced kidney.

The convalescence was retarded during the first three days by nausea and profuse vomiting, the vomitus being a brownish fluid. The pulse during the first few days was rapid and weak. The bowels were well moved on the fourth day, and after this the convalescence was uncomplicated.

The urine during the first day after operation measured 260+cc., the plus mark standing for an unknown amount which was lost; on the second day 625 cc., on the third day 275+cc., and on the fourth day 620 cc.

In a note made just before her discharge from the Hospital the slight brownish discoloration of the skin was noted as disappearing.

Pathological Examination of the Specimen Removed.—The specimen consists of the right kidney and a large retroperitoneal tumor. The tumor is irregularly globular in shape, measuring 11x11x13 cm., and presents a somewhat lobulated appearance, the larger nodules, which are three or four in number, averaging 3 or 4 cm. in diameter and projecting 1 or 2 cm. above the general surface of the tumor. One springing from the upper posterior portion is firm and resistant to the touch, the remaining nodules and the large tumor are distinctly fluctuant. The tumor is entirely enveloped in a vascular capsule with large and abundant vessels ramifying

through it, and where this is stripped off the tumor is of a yellowish color. Situated on the anterior surface of the tumor and attached to it by the lower four-fifths of its posterior surface by connective tissue is the slightly enlarged kidney, measuring 13x7x3.5 cm. The kidney for the most part has a deep red, mottled appearance, but presents a few bands or small areas of whitish fibrous tissue, and the upper portion of the anterior surface is occupied by an oval area 5.5 x 3 cm., which is of a yellowish-white color and slightly raised above the surrounding tissue.

Surrounding the tumor is a large amount of adipose tissue, and on the upper end of the kidney is a conical body 2.3 cm. long, firm to the touch and probably an enlarged lymph gland. Originating from the junction of the upper and middle thirds of the anterior margin of the kidney and crossing over the anterior convexity of the tumor is the flattened ureter resembling an empty vein.

After hardening in Müller's fluid and alcohol a cross-section through the kidney and tumor was made, dividing it into two equal halves, and it was then found that it was a thick-walled cyst, the walls measuring from 1 to 7 cm. in thickness, and the contents a thick yellowish colloid material. In several places in the wall, especially in the thicker portions which represented the bosses above spoken of, there were irregular cyst-like cavities containing the same colloid material. Sections made through various portions of the wall were studied microscopically and the following characteristics were seen. The cyst cavity had no definite limiting membrane, it being bounded by a layer of connective tissue poor in cell nuclei. Deeper in the tissue the character of the wall changed entirely. Here were found cells varying greatly in size and shape, some round, spindle, or irregularly shaped, and with round or oval rather lightly staining nuclei, with here and there a larger cell containing from 3 to 7 nuclei. These groups of cells were crossed in places by bands of lightly staining tissue. In other places again typical myxomatous tissue was found, and scattered through the wall were areas of connective tissue, which in places showed hyaline changes, and in others were thickly set with numerous small round cells, with round deeply staining nuclei. The tissue showed in places quite a number of blood-vessels, some being apparently formed of the tissue cells, while in other parts of the section the blood-supply is very poor, and this was specially noted where the hyaline changes were most marked. No suprarenal tissue was found in any of the sections.

The examination of the enlarged gland showed no metastasis, there being merely a hyperplasia of the tissue, which in places showed marked hyaline degeneration and commencing calcification. The kidney also showed no evidences of metastases; the whitish area above spoken of was due to a great increase in the interstitial connective tissue, with loss of the epithelium of the tubules and glomeruli, probably the result of interference with the blood-supply.

Diagnosis.—Fibro-myxo-sarcoma of the right suprarenal gland.

CASE II.—*Large Tumor in the Left Renal Region. Operation. Death.*

Mrs. C., white, aged 64, was admitted to the Johns Hopkins Hospital, February 11, 1897, complaining of a "lump" in the left side of the abdomen.

Her family history has always been good, and she has been a healthy woman, save for puerperal fever, which followed the birth of her child. The climacteric period appeared unusually early, menstruation ceasing entirely when she was but 30 years old. One year before her admission she began to feel badly, but complained of no definite illness. Two months ago she first noticed a tumor in the right side of the abdomen, about the size, at that time, of a goose egg, but which has since then grown rapidly, though without pain of any kind. She has lost flesh rapidly of late and feels weak and exhausted. The bowels have been obstinately constipated, and she complains of a sense of obstruction in the rectum. The urine never showed any signs of blood, and careful urinary examination, made after her entrance into the Hospital, showed a complete absence of blood from the urine.

The temperature taken twice daily for a week, between the time of entrance into the Hospital and the operation, was normal, only twice being found above 99°. There were no subnormal drops in the temperature. No brownish discoloration of the skin.

Physical Examination.—On inspection, a large rounded tumor can be seen filling the whole of the left side of the abdomen, with marked bulging of left flank below the ribs. There is no movement of the tumor with respiration. On palpation the tumor is found to be rounded, and no sharp edge can be felt. The surface is smooth, and the tumor has an elastic, almost fluctuant feel. It extends from just below the costal margin above, nearly to the level of the anterior superior spine below, and inward nearly to the median line. In its transverse diameter the tumor measures 20 cm. and measures 19 cm. from above downward. It is not tender on palpation, and is almost immovable, though with firm pressure it can be pushed slightly towards the median line. On percussion there is dull tympany over the lower inner portion, and here gurgling can be felt on palpation. The border of the liver can be palpated 2½ inches below the costal margin, and on pressure there is a sense of resistance and pain in the epigastric region.

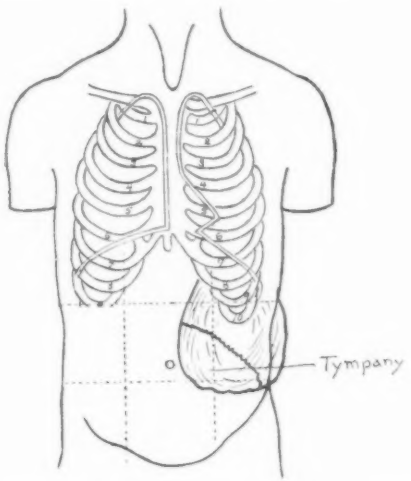


FIG. 2.—Shows position of tumor; the dark line is drawn to indicate where the tympanitic note ended.

The clinical diagnosis was "renal tumor" probably sarcoma from the rapid growth and elastic semifluctuant feel, though in this case, also, blood had never been found in the urine.

Operation.—The incision was made over the most prominent portion of the mass, beginning at the left linea semilunaris, on a level with the umbilicus, and extending around to the quadratus lumborum muscle, the incision measuring 25 cm. in length.

On opening the peritoneal cavity a large tumor was found occupying the left renal region, the surface being covered with extremely large veins. The kidney was displaced below and slightly behind the tumor, making it impossible to palpate it during the physical examination. The peritoneum was incised and pressed off the tumor by blunt dissection. Several large veins were cut and tied, but a great deal of blood was lost while attempting to free the tumor enough to reach the vessels below. By careful dissection, however, the tumor was partly raised from its bed, when on using a little more force than necessary the capsule ruptured, and masses of a soft tissue, looking like brain substance, poured out of the rent, accompanied by free hæmorrhage. After this the attempt to remove the tumor completely was given up, the principal masses being taken

out piece-meal, one portion of the tumor being removed with the kidney. The vessels were tied, and after washing out much of the detritus with hot salt solution, a drain was introduced and the wound closed. On removing the patient from the operating table, no pulse could be felt at the wrist, and the face and extremities were cold and clammy. On her return to the ward, the foot of the bed was raised, stimulants were freely given hypodermically, and 1000 cc. of salt solution were infused under the breasts, while the arms and legs were bandaged. In spite of this however, she never recovered consciousness, and died one hour after leaving the operating room.

No autopsy was permitted, so we were unable to settle the question of metastases.

Pathological Examination of the Tissues Removed.—The specimen consists of a left kidney and a large tumor mass, weighing together 2340 grams. The tumor was mutilated during the operation, and consists of several large masses, to one of which the kidney was attached by its anterior surface. The tumor consists of a thin membranous sac, in many places less than 1 mm. in thickness. Springing from the inner surface of the sac and forming the contents of the tumor are masses of exceedingly friable tissue which, where the degeneration is not too far advanced, present a fine papillary or thread-like structure. On section of some of the larger masses they are found to consist of a fibrillated, apparently myxomatous tissue, enclosing irregular masses of a soft brain-like substance. The surface of the tumor is covered by dense adhesions.

The kidney measures 13x5.5x5; its surface is irregularly nodular, the fœtal lobulations being well marked; the color is bluish or reddish. The lobules are in part firm and resistant, representing the fœtal lobulations; in other places they consist of thin-walled cysts, varying from 3 mm. to 2.5 cm. in diameter. Emerging from the upper and lower angles of the hilum are two ureters, and several large arteries are present in the hilum.

Microscopically, the thin membranous sac is found to be composed of connective tissue, with a few elastic fibres scattered through it; from its inner surface there are numerous bands of connective tissue extending inward toward the center of the growth, and in the meshes thus formed are found cells, varying greatly in size and shape, some being oval, some round and some very irregular. The nuclei of these cells are usually round or oval, though in places they are very irregular and stain deeply. Sections cut from the centre of the growth show the same characteristic structure, there being thick bands of connective tissue extending in various directions through the growth, and from these thick bands smaller bands are given, dividing the groups of cells, which in some places are packed in closely, and in others almost every cell is separated by a fine connective tissue fibril from the others; again, in other places, though the meshes are quite good size, only a few irregularly shaped cells are found in it.

The blood-vessels follow chiefly the bands of connective tissue, though in places one can see among the cells blood enclosed either by one layer of flat cells, or in some cases apparently limited by the tumor tissue.

The kidney showed metastatic growth, following closely in type the primary tumor.

Diagnosis.—Large, round-celled alveolar sarcoma.

CASE III.—*Globular Tumor in the Left Renal Region. Operation. Death.*

Mr. M., white, æt. 53, was admitted to the Medical Ward of the Johns Hopkins Hospital, June 18, 1896, complaining of the presence of a tumor in the right side of the abdomen. The patient has had the usual diseases of childhood but otherwise considered himself a healthy man, and denied any venereal infection. In January, 1896, or six months before his admission to the Hospital he suffered with an attack of severe pain in the left side, which his physician thought due to impaction of fæces and which was relieved by simple purgation, but after the pain had disappeared a lump was discovered in the same side of the abdomen, which never disappeared. Since then the patient has never had an acute attack like the first but has complained at times of some soreness localized in the left side and never radiating. The bowels have always been regular. The stools have never contained blood or mucus, and he has never vomited, nor showed any signs of jaundice. During the six months he has lost 20 pounds in weight and becomes very easily exhausted on any exertion. The urine has always been light in color and normal in quantity. The clinical and microscopical examinations of the urine revealed nothing abnormal.

Examination shows the patient to be a healthy-looking man, though there is a fairly well marked cachexia. The heart and lungs are normal. In the left hypochondrium extending into the epigastrium there is a prominence which fills the costal groove. On palpation, corresponding to this area, there is a firm mass occupying the left half of the epigastrium. The mass does not extend much beyond the middle line. Below, it slopes gradually and passes deeply into the posterior portion of the abdominal cavity. The deepest point can be felt almost on a level with the umbilicus.

Along the costal margin it can be felt passing deeply and filling in the upper part of the space between the costal margin and the iliac crest. Fingers in the renal region behind push the mass forward, though it is difficult to outline at times by bimanua palpation, and there is some tenderness on palpation.

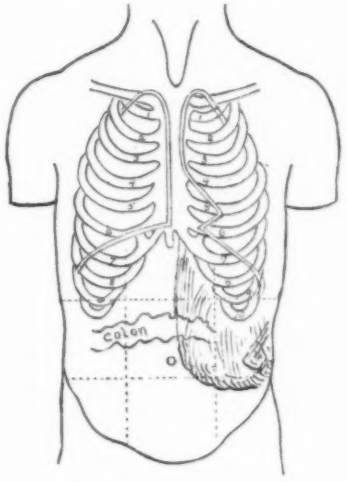


FIG. 3.—Shows position of tumor. Transverse colon, crossed inner portion.

The surface of the tumor is somewhat nodular in the flank and one nodular mass can be felt low down in the flank below the level of the umbilicus. Crossing the tumor transversely there is a large sausage-shaped mass, probably the colon.

After a week the patient was transferred to the Surgical Division and operated on by Dr. J. M. T. Finney, June 30, 1896.

Operation.—A transverse incision was made below the costal margin on the left side. The tumor was found to be quite adherent and was removed with difficulty, though there was no very marked hæmorrhage, and the tumor was not broken up during the removal. It was doubtful for a time from which organ the tumor sprang, and it was at first considered to take origin from the left kidney. This was found intact and was left behind during the removal of the tumor. The spleen was pushed high up under the diaphragm, and on studying the relations of the tumor more closely, especially its relations to the kidney, it was found to be undoubtedly supra-

renal in character. As the patient was in a bad condition no further search was made, and the wound was closed.

Death occurred at 2.45 A. M., about twelve hours after the operation, from shock.

Pathological Examination of the Specimen Removed.—The tumor is an irregularly round mass about the size of a child's head, hard and firm in consistence over most of its area, but on the anterior surface there are several soft cystic elevations, each about the size of an English walnut. On opening one of these a soft brownish material characteristic of sarcoma exudes, and through the opening a probe could be passed well into the centre of the growth.

Microscopical Examination.—The capsule is of dense fibrous tissue, with distinct areas of round-cell infiltration in places. The cells lying immediately beneath the capsule are irregular in shape and vary greatly in size, some large and oval, with irregular nuclei, others round, and others again almost spindle-shaped. Numerous connective-tissue bands divide the cells up into groups, and in several places the individual cells are seen separated by fine connective-tissue fibres. This alveolar arrangement can be seen in many places, some of the alveoli being filled with the irregular cells, while in others the cells are principally distributed around the edges.

In another portion of the tumor many small blood-vessels are seen surrounded by denser masses of cells, which apparently take origin from the small blood-vessels and suggest in their arrangement a perithelioma. Giant cells are found in several portions of the tumor, usually with many centrally placed nuclei, and a protoplasm, granular, and staining deeply with eosin, and there is also a small area in another portion of the tumor which looks like normal suprarenal gland tissue.

Diagnosis.—Alveolar sarcoma of suprarenal gland.

The histogenesis of these tumors is still a matter of discussion, and many observations have appeared on the subject chiefly in connection with the new-growths in the kidney, taking origin from aberrant suprarenal tissue. Upon this point very little of added importance can be obtained from my specimens.

One interesting thing, however, was noted in the microscopical examination of sections from the tumor in Case III. In this many of the smaller blood-vessels were found surrounded by dense groups of cells, which apparently took origin from the endothelial cells of the vessel wall, and the tumor might therefore be classed as a perithelioma, though I have considered it as an alveolar sarcoma, for the principal picture was of a tumor of this type.

The ages of patients affected varied widely, and in the sixty-seven cases comprising both the carcinomata and sarcomata, the youngest was only 9 months old, while the oldest was 73 years.

Out of 37 cases of carcinoma, 22 occurred in the male and 15 in the female sex. Mankiewicz,[51] from the statistics which he gathered, considered carcinoma more common in the male sex, he having found 7 cases in the male to 4 in the female, and my statistics bear out this view, though from the limited number very little dependence can be placed on the figures. The average age in the 37 cases was 43.4 years, the youngest patient being 3 years old, the oldest 73 years old, and both the youngest and oldest being females.

Table I shows in which decades the carcinomata occur most frequently:

TABLE I.

Age not given					=2
1 year	to	20	years		=5
20 "	"	30	"		=3
30 "	"	40	"		=7
40 "	"	50	"		=5
50 "	"	60	"		=8
60 "	"	70	"		=6
70 "	"	80	"		=1

The averages for the sarcomata were drawn from 30 cases, of which 14 occurred in the male and 11 in the female, the sex of five not being noted. In this group the preponderance of the male over the female sex is not so marked. The average age of the 30 cases was 31 years, the youngest being 6 months old, the oldest 64 years.

Table II shows the relative frequency of occurrence in the various decades of life:

TABLE II.

6 months	to	10	years		=8
10 years	"	20	"		=1
20 "	"	30	"		=2
30 "	"	40	"		=2
40 "	"	50	"		=7 (?)
50 "	"	60	"		=4
60 "	"	70	"		=2

I am sure that the above figures are not of much value in making the diagnosis between carcinoma and sarcoma, as some of the tumors classified as carcinomata were undoubtedly sarcomata, and probably vice versa, but they show that the male sex is more frequently attacked than the female.

SYMPTOMS.

In first studying the symptoms connected with a suprarenal neoplasm, a resemblance to the classical description of Addison's disease is immediately seen. This resemblance was first noticed by Addison himself while studying the disease which has received his name, and in his monograph[1] he speaks of two cases of secondary carcinoma of the suprarenal gland in both of which many of the symptoms were similar to those occurring in tuberculosis of the gland, and though the skin did not show the typical bronzing there was a peculiar dirty brownish color present, which, since then, has been noted by other observers as occurring in the new-growths of the suprarenal gland. From these two cases Addison classified malignant neoplasms of the suprarenal as one of the causes of Addison's disease.

On considering, however, more carefully the symptoms complained of in the cases collected, and in comparing them with the definition given by Addison, the resemblance is not nearly so marked, and especially the skin changes and the disturbances of the circulatory system are absent in most of our cases.

I will not attempt the question as to whether in Addison's disease, and of course also in other disturbance or destruction of suprarenal capsule, the symptoms, more especially the skin changes, are due to changes in the suprarenal itself, or to

involvement of the sympathetic nervous system, but will merely quote several interesting cases, as tending to prove that some of the symptoms may be due to involvement of the sympathetic fibres, rather than to changes in the suprarenal gland. Fleiner[61] described a case of primary carcinoma of the stomach with metastases to various abdominal organs, among them the suprarenal glands. There was a distinct bronzing of the skin and of the mucous membrane of the mouth, and besides the carcinoma of the suprarenal there was a carcinomatous involvement of the abdominal sympathetic nerves. Leva[19] describes two cases of primary suprarenal new-growth without pigmentation, in which the abdominal sympathetic nerves were not involved, and explains the common absence of bronzing in this affection by the idea that the bronzing is due rather to involvement of the sympathetic nerves than to changes in the suprarenal gland, and he thinks tuberculosis is much more apt to involve the sympathetics, and therefore, more apt to cause the bronzing.

The case of Fleiner seems to bear out Leva's theory quite well, and it seems rather strange, to say the least, that if the pigmentation is due to destruction of the gland alone why we should not always see it in malignant growths.

In the attempt to classify the symptoms, carelessness in reporting cases gave much trouble; I found also a certain number of cases in which the symptoms given were evidently due to other diseases, which were either the actual cause of death, or which were so marked as to mask the suprarenal symptoms.

In the 67 cases collected there were only 37 which could be used in studying the symptoms. In these, the following symptoms were seen, cited in the order of frequency.

The most frequent symptom, seen in 22 patients, was a marked and steadily increasing loss of strength, accompanied in many cases by extreme languor and debility. Affleck and Leith[26] call especial attention to this languor in a case which they report, and say that "the difficulty of arriving at any diagnosis was enhanced by the natural apathy and indifference of the patient, due, no doubt, to the disease." Emaciation varying greatly in degree was noted in 20 cases; in some of these the loss of flesh was apparently not very marked, though in a few it was noted as extreme.

The intestinal system was the next attacked, in point of frequency: twelve patients out of 37 complained of nausea and vomiting. In nine there was loss of appetite; in four, diarrhœa; and in five, constipation. The circulatory system as compared to Addison's disease was rarely involved: four patients complained of palpitation of the heart, and in one the pulse was weak and thready. Six suffered with œdema of the legs, due in most of the cases at least to renal changes and not connected with the new-growth. Anæmia, varying from slight pallor to a high grade, was noted in seven cases.

Of interest is the fact that though there was extension of the growth into the vena cava and thrombosis, in four or five cases, these did not suffer with œdema. Affleck and Leith[26] call attention to this fact, and explain it by the collateral circulation which is established.

Complaint of pain located in various parts of the body was made in 25 cases. In some it was found in one or the other renal regions behind; again it occupied the whole back, extending upwards into the shoulders, or downward into the thighs; others again complained of pain in the epigastrium or in one or the other hypochondriac regions; and in several there was marked tenderness on pressure either in the epigastrium or over the tumor. The pain was usually of an intermittent character when present, though occasionally it was continuous. In one case there was such severe pain in the knee and ankle joints that the medical attendant considered the patient to be suffering with rheumatism.

The skin changes were usually not marked; three out of the 37 showed distinct bronzing of the skin, and in nine there was some change in the color or texture of the skin, as for instance several patients were described as having a slight brownish discoloration; in others the skin was muddy looking, or of a yellowish color. In three patients there was marked jaundice due to coincident hepatic disease. In two there was a peculiar profuse growth of hair; both of these cases were in young female children, the one reported by Cayley[6] was a girl of three years, in whom the eyebrows were thick and bushy, and there was a line of dark hair on the upper lip. Fox's[45] case was a girl, also of about three years, spoken of as gross and bloated, with the whole body surface remarkably hairy, especially about the genitals and pubic regions.

Sleeplessness is noted by Hausmann[16] as occurring in a case reported by him, and he quotes Addison who has spoken of its occurrence in Addison's disease. I have not noted this symptom in any of the other cases; on the contrary, the tendency of the disease is to give rise to dulness and apathy.

The temperature is usually normal, there being but three cases in which any marked rise of temperature above the normal was noted, and in these three the rises of temperature were due to coincident lung disease. Berdach[37] is inclined to think malignant disease of the suprarenal is often accompanied by a lowering of the temperature, and he has reported a case illustrating this view, and to prove his theory has experimented with dogs by removing both suprarenals, with the result of lowering the temperature in every case. The reported cases, however, do not bear out his view, and I have found only one other in which any record of the lowered bodily temperature was made. The temperature in all three cases in my list was either normal or slightly above the normal occasionally.

Hæmaturia has been noted twice in the 67 cases, and this is important, as it makes the differential diagnosis between renal and suprarenal tumors more difficult. In one case reported by Troisier,[32] the hæmorrhage was due to a secondary cauliflower growth in the renal pelvis, and the hæmorrhage in the second case was due, evidently, to cystic changes in the kidney, as there had been a tumor present in the renal region for eight years, during which time the hæmorrhage had lasted, and at the autopsy, besides a primary sarcoma of the suprarenal gland, the palpable tumor previously felt was found to be a cystic kidney.

The presence of a tumor was noted a good many times, but in such a way that it was impossible in some of them to tell whether it was not first seen post mortem, and as a careful description of its appearance, position and relations was never given, it would be useless to merely cite the number of times in which a tumor had been noticed.

I wish next to call attention to a certain number of cases in which the new-growth caused no symptoms referable to the suprarenal. Out of the 67 cases, 13 can be grouped under this heading. There were five in which the symptoms were entirely confined to the respiratory tract; one died of pneumonia, another of gangrene of the lung, two from extensive metastatic growths in the lung, the symptoms being entirely referred here, and in the fifth case, the only symptoms were an intense bronchitis and weakness.

Of the remaining eight cases several were interesting; for instance Wallman[33] reports a case of a young dragoon corporal who, admitted to the Hospital for the treatment of an ulcer over the shoulder blade, was suddenly attacked by œdema of the glottis. At the autopsy scirrhous changes in the right suprarenal gland were found. Greenhow[14] had a patient, a young girl aged twelve, who, two months previous to her death had scarlet fever, and following this a general œdema, but no symptom referable to the suprarenal, though she had quite an extensive growth in this gland. Wigglesworth[34] also reports the case of an old woman dying of "general decay following cerebral atrophy," and at the autopsy marked carcinomatous changes were found in the suprarenal gland. The remainder of the eight cases gave about the same history.

Diagnosis.

That the diagnosis is very difficult, and in some cases impossible, cannot be doubted, but I think with careful study of the cases which we may see, there are at least a certain number in which a diagnosis might be made. In considering the symptomatology, the most striking symptoms are the marked and steadily increasing loss of strength often accompanied by great languor and debility; the pain usually deeply seated in the abdominal cavity or radiating from one or the other renal regions; the marked emaciation and the various digestive and intestinal disturbances, added to which are in some cases the slight skin changes. If, in addition to these symptoms, there is a tumor present in one or the other renal regions we have a set of symptoms which, while not characteristic, are suggestive, and which would point to the possibility of a suprarenal origin. These symptoms are, unfortunately, not always present, and in the reported cases it is rare to find the whole set clearly marked, especially in combination with an abdominal tumor. The cases in which no abdominal tumor can be palpated are of course much more difficult to diagnose, and I doubt if in these a positive diagnosis can be made. Affleck and Leith[36] report a case of this kind, the patient having great and increasing weakness, gradual emaciation, loss of appetite, nausea and vomiting, and pain in the loins, passing thence around the abdomen and down into the thighs. There were no skin changes and no tumor palpable. This case was not diagnosed during life, though most of what we may call the cardinal symptoms were present.

The foregoing being the principal symptoms on which a diagnosis may be based, what are the other conditions which may simulate a suprarenal neoplasm?

The first of course to be studied are other changes occurring in the suprarenal gland itself. Of these the only ones which can be mistaken for a malignant tumor are blood cysts and occasionally tuberculosis, the so-called adenomata being usually very small and giving rise to no symptoms.

Blood cysts of the suprarenal are rare. Drouboix[59] has collected a number, and I have been able to find several others. Their origin is not at all clear, but they are probably the result of a necrosis in the centre of a new-growth, usually an adenoma with a subsequent hæmorrhage into the necrotic area. The symptoms in some of the reported cases are exactly those of a malignant tumor, and I do not see here how a differential diagnosis would be possible. I will quote two of the most striking ones as of interest. Carrington's[58] case occurred in a Swede aged 54 years. He gave a history of gradually increasing languor and weakness, and gradually increasing epigastric pain, for two months preceding his entrance into the Hospital. On admission he was weak and languid, somewhat emaciated, his mind wandering at times. No nausea or vomiting was complained of. On examination a tumor was felt in the epigastric region, descending with respiration and tender on pressure. There was a darkening of the skin around the nipples and on the penis and scrotum, and this pigmentation became more marked before his death, which occurred three weeks later. At the autopsy both adrenals were found changed into cysts, globular in form and about the size of an orange. On section they were found filled with a light brown, grumous altered blood. The cyst walls on microscopial examination were found composed of normal suprarenal tissue. Floersheim and Ouvry[60] also report a blood cyst of the left suprarenal which simulated a new-growth. The patient was a woman aged 36, who began to suffer three years before with pain in the lower portion of the left chest, becoming worse after eating and causing attacks of dyspnœa and a feeling of constriction. Examination revealed a hard mass in the left hypochondriac region in the position of the left kidney. The urine was normal. She was operated upon, a median incision being made, and the tumor was found to be a retroperitoneal cyst. It was punctured and three litres of a brownish fluid were evacuated. The walls of the cyst were then attached to the walls of the incision and the wound was dressed. The patient died of peritonitis, and at the autopsy the cyst was found to be retroperitoneal, the kidney lying below and attached to it by the convex border. The walls of the cyst which were from 6 to 7 mm. in thickness, were found on microscopical examination to be composed of suprarenal tissue.

That tuberculosis of the suprarenal might simulate a new-growth is also easy to conceive, though it is rare to find a palpable tumor in these cases. A. F. Jonas[61] has just published a case which demonstrates this. The patient had a palpable tumor in the renal region with symptoms pointing to a suprarenal tumor. Dr. Jonas did an exploratory operation and was able to remove the suprarenal growth which proved on examination to be tubercular. The patient got well.

Tumors of the kidney are most often confused with suprarenal growths, and among the collected cases I found eight in which the diagnosis of renal neoplasm had been

made. This is not surprising when we consider that the suprarenal tumor is retroperitoneal, and occupies the same position as would an enlarged kidney. The differential diagnosis is based on the difference in the symptoms complained of in the two conditions, and on the presence of hæmaturia accompanying the renal neoplasm. This symptom, according to most observers, occurs in about 50 per cent. of renal neoplasms, and its presence might be considered conclusive, though as we have seen above, hæmaturia was present with two cases of suprarenal tumor, in one due to a secondary carcinoma in the renal pelvis, and in the other to advanced cystic disease of the kidney.

Rarely the kidney may be felt displaced by the suprarenal tumor, as occurred in Case I of our series, though even when felt it is difficult to recognize as the kidney. This possibility as an aid to diagnosis has also been noted by Pawlik in an article on renal surgery in one of the German journals.

Tumors of the liver have also been diagnosed where the trouble was really in the suprarenal, though in these cases the diagnosis has been entirely based on the presence of a large tumor in the hepatic region, and careful consideration of the symptoms and a painstaking physical examination would, in most cases at least, serve to distinguish the two.

Other conditions might also simulate a suprarenal tumor, as Berdach[26] in his article discusses the possibility of differentiating from retroperitoneal glands or a pancreatic cyst or neoplasm. Especially with a pancreatic cyst one could imagine the diagnosis to be difficult, as here also we get the emaciation, epigastric distress and nausea and vomiting, but the tumor is usually differently situated, and there are other symptoms which do not occur with the suprarenal disease.

Having considered the diagnosis it may be of interest to review our cases again briefly.

In Case I it seems now that the diagnosis should have been made, as she had many symptoms pointing to the suprarenal origin of the tumor. The presence of the kidney-shaped prominence on the surface of the tumor, the complete absence of blood from the urine throughout the whole illness, the slight brownish discoloration of the skin and the steady loss of flesh and strength were all of importance.

Case II would have been more difficult to diagnose correctly, as the symptoms were not so definite, and save for the complaint of feeling weak and badly and the rapid loss of flesh, there were no definite symptoms pointing to the suprarenal origin.

Case III was also diagnosed by the surgical staff without hesitation as a renal new-growth, and it was not until the incision was made that its true character was seen.

TREATMENT.

The treatment must necessarily be surgical, and unfortunately there have not been enough cases operated upon to be able to draw any very definite conclusions from them, so the indications and probable prognosis will have to be largely obtained from a study of the symptoms, duration, and post-mortem discoveries.

One learns first from a study of the symptoms that the disease is insidious in its onset, which tends to make an early discovery of it rare, and when once developed the condition of the patient rapidly grows worse; and on this account any severe operation is more dangerous than it otherwise would be. That the course is a rapid one is shown in the fact that the average duration in 26 cases of carcinoma was, from the onset of the first symptom, 10.6 months, the least duration being 6 weeks and the longest 36 months. In sarcoma the average duration from the onset of the first symptom was even shorter, being but 6.7 months, the least duration one month and the greatest 13 months.

In examining the autopsy reports one finds there also several striking points which would evidently have an important bearing on the question of successful operation.

The first question which arises naturally when there are two organs of the same character in the body and one is to be removed, is what is the condition of the opposite organ? and when the retention of one is necessary to life this is a very vital question. This of course can only be answered in an incomplete way from the findings at autopsy, as necessarily in these cases the most ample time possible is given for the formation of metastases, but even with this the observer cannot but be struck with the great frequency with which both glands are involved, and also by the fact that in so many cases the glands on both sides are so nearly equal in size and general appearance, denoting either a simultaneous primary involvement or very early metastases. This is more especially marked in the carcinomata, there being in 30 cases where the side affected was noted 17 in which both glands were involved, the right side being alone affected in 6 and the left side in 7. Among the sarcomata this was not so marked; in 28 cases where the side was noted only 8 had both glands involved, the right alone being sarcomatous in 10 and the left in 10.

The frequency of metastases is also important, and the study of these from the post-mortem room is open to the same criticism, namely, that they had the longest possible time to develop, and that we should not be so likely to find them at an early operation. I attempted to get further light on this by studying the number of organs involved in the metastases and their apparent age, but found it impossible to get any reliable figures because of the incompleteness of the reports, but gathered enough to convince myself that the metastases in a good proportion of the cases occurred quite early, and were pretty widely diffused. In the carcinomata there were 28 cases where metastases were found in one or more organs, and in only three were they noted as not being present. The other six cases were so incompletely reported that their presence or absence could not be determined. In the sarcomata the metastases were not so frequent, being present in 14 cases, noted as not present in 6 cases and in 10 cases it was impossible to tell from the report whether present or not.

Among the carcinomata the organs most frequently affected were the lung in 15 cases, the kidney in 13 cases, the liver in 11 cases, the retroperitoneal glands in 7 cases, the stomach in 5 cases, the pleura and heart in 4 cases each, and almost every other organ in the body was noted as involved once or twice.

The sarcomata affected the liver in 6 cases, the kidney in 5

cases, the lung and the pleura each in 3 cases, and most of the other organs once or twice.

From these facts we may justly conclude, first, that an early operation is of vital importance, as, because of the insidious onset and rapid course, we will have to combat later, besides the difficulties of the operation itself, the lowered vitality and the lowered resistance of the patient. Second, that because of the probable early occurrence of metastases and the frequent involvement of both glands, the prognosis for final cure, even in the result of a successful operation, is unfavorable to say the least. Third, that because of the less frequent involvement of both glands, and the less frequent metastases, the prognosis in sarcomata is more favorable than in carcinomata.

The study of the difficulties occurring during the operation, and the results following it, naturally come next, and though we have but five from which to draw any conclusions, there are several interesting facts to be obtained from them. The cases are the three which I have reported, a case reported by Roberts,[68] of Philadelphia, with a fatal result, and two so-called suprarenal tumors removed by Knowsley Thornton,[63] with good results and briefly mentioned in his monograph "Surgery of the Kidneys." Only one of these can be used, as the other was undoubtedly a new-growth in an aberrant suprarenal gland in the kidney, for he speaks of the tumor as being surrounded by kidney tissue. Of these five, three resulted fatally: two immediately following the operation, and one in three weeks.

In Case I of our series the growth was firm and well outlined, and not adherent, and though some trouble was experienced in raising it from its bed and tying the vessels, the operation was not especially difficult, and except for the removal of the kidney with the tumor, gave no cause for anxiety, and as the result showed was perfectly successful. No troublesome hæmorrhage occurred during the removal. This case illustrates the most favorable growth that could be encountered. In our second case, however, a growth of a different character was found, illustrating well one of the difficulties which will be met, namely, a soft, friable tumor which when handled the least roughly breaks down and gives rise to almost uncontrollable hæmorrhage, besides making it impossible to remove it entirely. Dr. Roberts encountered the same difficulty in his case, and was compelled to abandon the operation because of the hæmorrhage before all of the growth had been removed, and his patient died three weeks later.

In Case III, while the tumor was removed entire, there was free hæmorrhage, and though the patient recovered from the anæsthesia, he died eight or nine hours later from shock, probably due to the long operation and his weakened condition.

In Dr. Thornton's case no acccount of the operation was given.

We find from these that the principal difficulties during the operation are free hæmorrhage and a tendency of the growth to break down during removal, and to these may be added the probability of dense adhesions, as in the pathological reports of many of the cases the tumor was noted as densely adherent to the surrounding organs, most often on the right side to the liver.

In spite, however, of the unfavorable outlook for a successful operation, it is best that at least an immediate exploratory operation should be advised in all cases where there is suspicion of a suprarenal new-growth being present, and this is even more true when a tumor is palpated, as we must remember that without operation the result will necessarily be rapidly fatal.

The question as to whether a further operation should be done in the event of finding a suprarenal tumor will depend on the character of the growth itself, the condition of the other gland, the absence of any visible metastases and the absence of dense adhesions. If the further operation is decided upon it is wise to remove the corresponding kidney, as we have seen that in 31 cases of carcinoma metastases were present 11 times.

The final result in our one successful case has been good so far, the patient being healthy and with no signs of any return of the growth.

Summary.

To summarize we find the following facts true: 1, that while malignant tumors of the suprarenal gland are rare, they should be considered as one of the factors to be eliminated in the presence of an abdominal tumor; 2, that they are somewhat more common in the male sex; 3, that while in a certain proportion the symptoms are fairly well marked, there are many in which no symptom points to the suprarenal origin; 4, that rapid loss of strength, debility, emaciation, digestive disturbances and abdominal pain are the most prominent symptoms; 5, that skin changes are rather the exception than the rule; 6, that they run a rapid course, the duration being shorter than usual with a neoplasm in other organs; 7, that the diagnosis is impossible in many, and difficult in all, cases; 8, that a differential diagnosis must be made from other suprarenal diseases, from renal tumors, from hepatic tumors, from diseased retroperitoneal glands, and from cysts and new growths of the pancreas; 9, that the prognosis is always serious, even following a successful operation, from the great frequency with which both glands are found involved, and the tendency to early metastases; 10, that operation gives the only hope of relief, and that it has been successful in two cases; 11, that the principal difficulties in the operation are, the friability of the tumor, the great tendency to hæmorrhage, and the frequency of adhesions.

Literature.

carcinoma.

1. Addison: On the Constitutional and Local Effects of Disease of the Suprarenal Capsules. London, 1855.
2. Ball: Bull. Soc. anat. de Par. 1858, p. 423.
3. Berard: Lyon Méd. April 29th, 1894, p. 583.
4. Besnier: Bull. Soc. anat. de Par. 1857, XXXII, p. 85.
5. Birsch-Hirschfeld: Lehrbuch der Path. Anat. 1877.
6. Cayley: Tr. Path. Soc. Lond. 1865, Vol. XVI, p. 250.
7. Dickinson: On Renal and Urinary Affections. Part III, p. 722.
8. Doederlein: In. Diss. Erlangen, 1860.
9. Duclos: Bull. gén. de thérap. méd. et chir. Paris, 1863.
10. Falconer: Brit. Med. Journal. 1861, Vol. II, p. 662.
11. Foster: Averbeck. Die Addison'sche Krankheit. 1869.

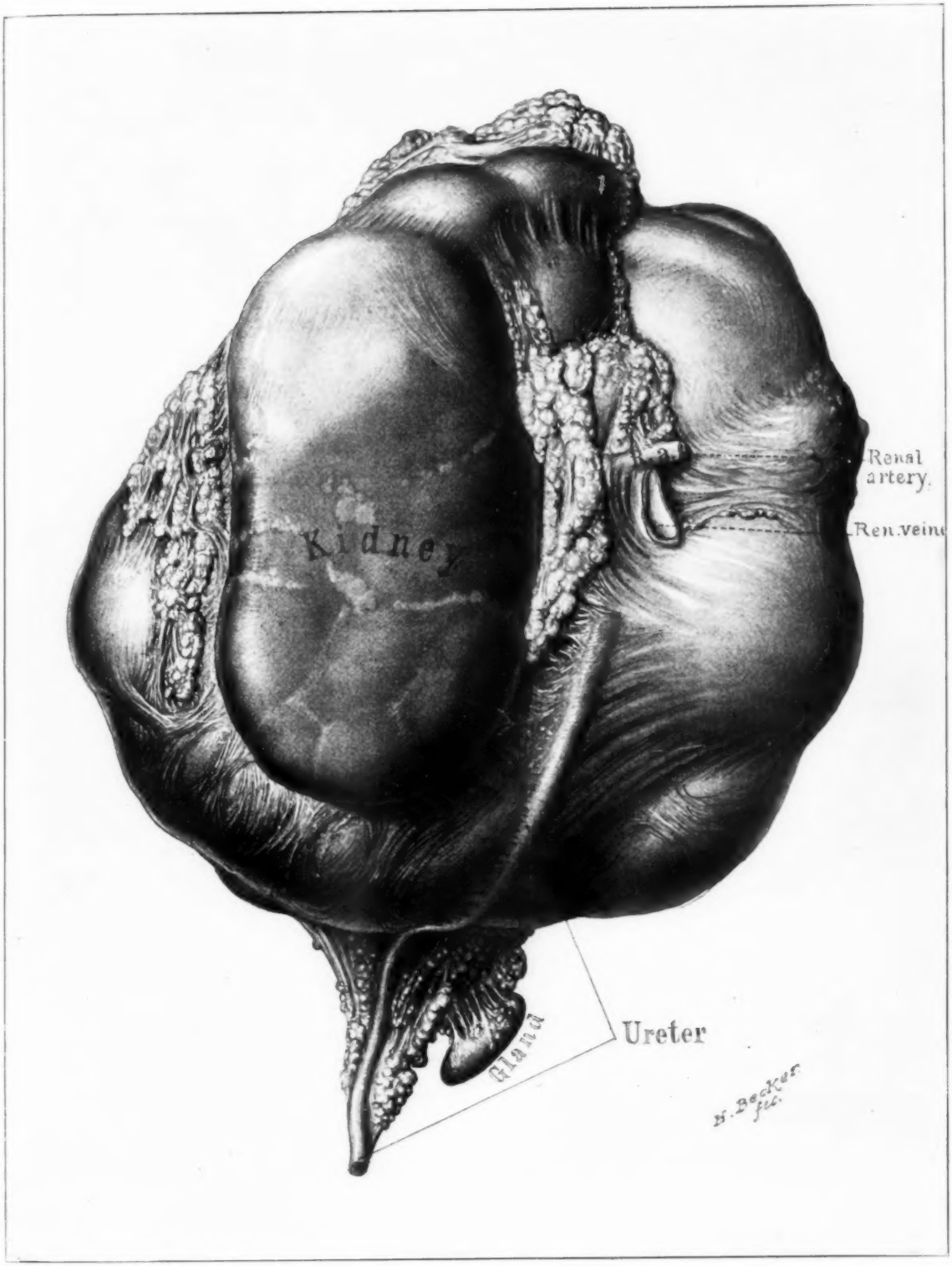


FIG. 1.—Tumor with kidney attached. Natural size. Case No. 1.

FIG. 2.—Same tumor cut in two. Shows the gelatinous contents of cystic cavity. The smaller size is due to the hardening process, as is also the dark color of the gelatinous material contained in the cyst.

12. Fräntzel: Berl. klin. Wchnschr. Dec. 1867, No. 51, p. 536.
13. Gairdner: Month. J. M. Sc. London and Edinburgh, 1850, X, p. 382.
14. Greenhow: Tr. Path. Soc. Lond. Vol. XVIII, p. 260.
15. Haddane: Edinb. Med. Journal. 1861, Vol. VII, p. 586.
16. Hausmann: Berl. klin. Wchnschr. 1876, Bd. 45, p. 648.
17. Kirkes: Med. Gazette. Vol. XXXV, p. 35.
18. Klebs: Handbuch der. spec. path. Anat. Berlin 1876.
19. Leva: Arch. f. path. Anat., etc., Berl. 1895, Bd. 125, p. 65.
20. Lubet-Burbon: Le Progrès Med. 1885, Vol. II, p. 556.
21. MacGillivray: Austral. Med. Journ. Melbourne, 1868, Vol. XIII, p. 294.
22. Marchand: Internat. Beitr. z. Wissensch. Med. 1891, Bd. 1, p. 537.
23. Martineau: De la Maladie d' Addison. p. 67.
24. Mettenheimer: Deutsche Klinik. 1856.
25. Murchison: Tr. Path. Soc. Lond. 1857, Vol. IX, p. 400.
26. Pawlik: Centralbl. für Gynäk. 1897, p. 1027.
27. Peacock and Bristowe: Tr. Path. Soc. Lond. 1856, Vol. VIII, p. 337.
28. Ritchie: Edinb. Med. Journ. 1890, Vol. XXXII, p. 12.
29. Sapelier: Bull. Soc. anat. de Paris. 1881, p. 264.
30. Schuchardt: Breslauer ärztliche Zeitschr. 1883, Sept. 8.
31. Stoukoventoff: Gaz. Méd. de Par. 1895, Dec. 7, No. 49, p. 581.
32. Troisier: Bull. et mém. Soc. méd. d' hôp. de Par. 1890, 3 S., VII, p. 266.
33. Wallman: Zeitschr. d. k. k. Gesellsch. d. Aerzte zu Wien. 1860, p. 784.
34. Wigglesworth: Liverpool Med.-chir. Journ. 1892, XII, p. 254.
35. Wilks and Hutchinson: Tr. Path. Soc. Lond. Vol. VIII, p. 255.

SARCOMA.

36. Affleck and Leith: Edinb. Hosp. Rep. 1896, Vol. IV, p. 278.
37. Berdach: Wien. med. Wchnsch. 1889, Vol. XXXIX, p. 357.
38. Blackburn: Jn. Am. M. Ass. 1888, Vol. X, p. 137.
39. Cohn: Berl. klin. Wchnschr. 1894, p. 266.
40. Caillé: Arch. Pediat. Aug. 1895, p. 594.
41. Drozda: Jahrb. d. Wien. k. k. Krankenanst. IV, 1895.
42. Earle and Weaver: J. Am. M. Ass. 1894, Dec. 29, p. 980.
43. Eberth: Arch. f. path. Anat., etc. Berl. Bd. 54, p. 21.
44. Heinrich Ermi: In. Diss. Zurich, 1879.
45. Fox: Tr. Path. Soc. Lond. 1885, p. 460.
46. Fränkel: In. Diss. Freiburg, 1886.
47. Griffiths: Brit. Med. Journ. 1889, Feby. 22, p. 242.
48. Jones: Deutsche med. Wchnschr. 1894, p. 208.
49. Kussmaul: Wurzb. med. Ztschr. 1863, No. 24.
50. Lazarus: Med. Press and Circ. London, 1894, May 2, p. 467.
51. Mankiewicz: In. Diss. Strasburg, 1887.
52. Merkel: Ziemssen Handb. der spec. Path. and Ther. 1874.
53. Perry: Brit. Med. Journ. 1888, Vol. I, p. 1382.
54. Pilliet: Bull. Soc. anat. de Par. 1888, p. 716.
55. Posselt: Wien. klin. Wchnschr. 1894, No. 35, p. 630.
56. Roberts: International Clinic. Series III, Vol. I, p. 203.
57. Rosenstein: Arch. f. path. Anat., etc. Berl. 1881, Bd. 84.
58. Turner: Tr. Path. Soc. Lond. Vol. XXXVI, p. 464.

MISCELLANEOUS.

59. Droubaix: Thèse pour le Doctorat. Paris, 1887.
60. Floersheim and Ouvry: Bull. Soc. anat. de Paris. 1895, p. 73.
61. Jonas: West. Med. Review. Lincoln, Nebr., Vol. III, No. 1, 1898.
62. Kelynack: Med. Chronicle. 1897, Sept., N. S., Vol. III, No. 6.
63. Thornton: Surgery of the Kidneys, being the Harveian Lectures, 1889. London, 1890.
64. Fleiner: Berl. klin. Wchnschr. 1889, No. 51, p. 1101.
65. Carrington: Tr. Path. Soc. Lond. 1885, Vol. XXXVI, p. 454.

THE BACTERIOLOGY OF THE CAVITY OF THE CORPUS UTERI OF THE NON-PREGNANT WOMAN. A REPORT OF 68 CASES.

BY G. BROWN MILLER, M. D., *Assistant Resident Gynæcologist, The Johns Hopkins Hospital.*

So much has recently been written concerning the bacteria of the female genital tract that unless one proposes to publish a book upon the subject, as has been done by Menge and Krönig, a complete and careful review of all the literature relating to it is impracticable. I will refer those who wish to have this, to the work of the above-named authors, "Bakteriologie des weiblichen Genitaltractus, Leipzig, 1897." I will here briefly review the work done by the more prominent investigators upon the bacteriology of the uterine cavity, and then add the data obtained by my own investigations. This work relates only to bacteriological examinations of the cavity of the corpus uteri, but in order to make some of my conclusions clear I will briefly give the status of the bacteriology of the vagina and cervix at the present time.

The vaginæ of both pregnant and non-pregnant women can be regarded as being, under normal circumstances, free from pathogenic bacteria. The introitus vaginæ is the outer boundary of this aseptic zone. The normal vagina contains its peculiar micro-organisms, but the pathogenic bacteria, when introduced into it, quickly disappear. The abnormal cases in which the vagina may contain pathogenic bacteria are cases of gonorrhœa, acute wound infections extending into the vagina, where the secretions of infected uteri, etc., are being constantly poured into the vagina, those cases in which the vagina contains dead nutrient media as in carcinoma of the cervix uteri with hæmorrhage and necrosis, cases of retained placenta, of necrotic submucous myomata, uterine polypi, and in tuberculosis of the vagina. This, in general, is in accordance with the views of Döderlein, Menge, Krönig, Williams and others, and the weight of evidence is decidedly in its favor. Opposed to this view are Ahlfeld, Kaltenbach, Walthard, Vahle, Kollman and others, who think that the streptococcus and the staphylococcus pyogenes, the colon bacillus and other pathogenic bacteria are to be found in a large percentage of all vaginæ.

The cervical canal is likewise, under usual circumstances, free from pathogenic bacteria, and from a point at or just above the external os contains no bacteria whatever. The gonococcus of Neisser and possibly the bacillus of tuberculosis alone have the faculty of invading unaided the normal

cervical canal, but under conditions mentioned in connection with the vagina, that is, a necrotic or patulous cervix coupled with dead nutrient material in its canal along with similar disturbances of the aseptic properties of the vagina, other bacteria, indeed the streptococcus and staphylococcus pyogenes, may invade the cervix without their introduction by means of external agencies.

The mucosa of the corpus uteri may either be free from or show inflammatory changes, and it is well in studying the bacteria of the cavity of the uterus to classify the cases according to whether the mucosa shows this endometritis or not. Most writers classify endometritis into *glandular* where the uterine glands show hypertrophic or hyperplastic changes without infiltration of the mucosa with small round cells or polymorphonuclear leucocytes, and into *interstitial* where this infiltration occurs. As most investigators agree that bacteria are not present in the glandular type of endometritis, and as in many cases this form of endometritis seems to be not dependent upon bacteria, I think it well to follow the classification made by Dr. T. S. Cullen, and will speak only of endometritis in the cases where this infiltration occurs. I will follow his subdivision further in classifying it into acute and chronic with the intermediate subacute stage. In acute endometritis there are changes in the epithelium, infiltration of the mucosa with small round cells and polymorphonuclear leucocytes and increase in the number of blood-vessels without increase in the connective-tissue elements. In chronic endometritis there is less change in the epithelium, an infiltration of the mucosa with small round cells, increase in connective tissue, thickening of the walls of the blood-vessels, and generally atrophic changes in the uterine glands. When the uterine cavity contains a considerable quantity of pent-up pus so that its wall may be likened to the sac of an abscess cavity the condition is known as pyometra. Physometra or tympania uteri is the condition in which the uterine cavity contains gas.

In the autumn of 1894, at the suggestion of Prof. H. A. Kelly, and of Dr. Jno. G. Clark, then resident gynæcologist of the Johns Hopkins Hospital, I began the bacteriological examination of the body cavity of uteri removed by the method then in vogue in this clinic and in America generally, *i. e.* supravaginal amputation of the uterus. Circumstances prevented the examination of many of the cases operated upon, and absence from the Hospital and other causes prevented me from securing the number desired. However, I have examined the body cavity of sixty-eight uteri removed for a variety of causes, and I give in the table a summary of the results obtained. The relative numbers of cases of carcinoma, myoma, etc., examined do not represent the proportion of such cases operated upon in the Hospital. Very few of the carcinoma cases were examined bacteriologically, as the bacteriological examination destroyed, to a certain extent, the histological value of the specimen. The technique observed in making the bacteriological examination was as follows: As soon after the removal of the specimen as possible, and before it was handled, to burn thoroughly the amputated end of the organ, and then invade the cavity through the cervical canal with a platinum loop which had been heated to redness. As a rule, cover-glass preparations of the secretions thus obtained were stained and examined microscopically, and cultures made upon various nutrient media. The cover-glasses were stained for bacteria by the usual methods. Gram's method of staining and the usual stain for the bacillus tuberculosis were used where indicated. The cultures were made upon agar slants or Petri dishes, stab cultures upon glucose agar and acid gelatin, and smears upon cyst-fluid agar or ascitic fluid agar or urine blood-serum agar, when these media could be obtained. I have also prepared a table containing a brief abstract of the histories of the cases, trying in these abstracts to embody everything relating to the nature of infection the operation, the convalescence, and the histological and bacteriological reports. As this table was too voluminous to be included in this article, the table given was prepared from it. This was deemed advisable, as Sänger and other prominent writers have emphasized the fact that clinical signs are as much or more to be depended upon in diagnosing gonorrhœa in women than the microscopical examination of the secretions, and undoubtedly a combination of clinical signs and the bacteriological examination is the true method in making a diagnosis.

In glancing over the table, we see that of the 68 cases, 53 showed changes of an inflammatory nature as indicated either by endometritis, or by inflammatory changes in the uterine adnexa. The uterine mucosæ in 51 of the cases were examined histologically, and 19 of these showed an acute, or subacute, and 12 a chronic endometritis. Eighteen of the cases showed no inflammatory changes in the endometrium. In *none* of the cases where there was no endometritis were bacteria found in either the stained specimens or in cultures. This, as we shall see later, corresponds entirely with the prevailing views upon the subject, *i. e.* that the body cavity of the normal uterus is free from bacteria. Concerning the bacteria found: the gonococcus was found seven times, the streptococcus pyogenes once, the staphylococcus pyogenes aureus once, the staphylococcus pyogenes albus twice, the bacillus of tuberculosis twice, and unidentified saprophytic bacteria four times. We have just stated that the gonococcus was found seven times, three times by cultures and cover-glass preparations, and four times in the stained specimens only. The micro-organism was found five times in the cavity of the corpus uteri, and twice in the pus from a pyosalpinx or ovarian abscess, and not in the uterine cavity. In all of these cases the typical biscuit-shaped diplococci were found in the pus in large numbers, lying both intra- and extra-cellularly, and decolorized by Gram's stain. The cultures were also characteristic. In another case the micro-organisms were probably found, but in such small numbers that Gram's stain was unsatisfactory. It was never found in the chronic cases of endometritis. In one case, where the gonococcus alone was found, there was an abscess in the uterine muscle, although the abscess cavity was not proven to contain the micro-organism. This cavity was not discovered until sections were cut for histological examination. One case showed a gonorrhœal pyometra. The woman gave a history of an infection following a miscarriage. Upon dilating the cervical canal, about three drams of a thin, odorless, yellowish pus escaped.

This pus contained gonococci in large numbers. There was in this case a stenosis of the os uteri, probably either by a dilated cervical gland, or swelling of the mucosa as a result of the inflammation. Another woman, who gave a history of an infection immediately following a miscarriage, proved to be infected by the gonococcus alone. The micro-organisms were found at the operation in the secretions from Bartholin's glands, urethra, vagina, external os uteri, the cavity of the uterus, the acutely inflamed tubes, and in pus found in the peritoneal cavity among coils of intestines. The gonococcus was never found accompanied by other bacteria. It was found once in a myomatous uterus.

Of all the bacteria, the gonococcus is by far the most frequent invader of the uterine cavity. This micro-organism has the faculty of invading the uterus through the previously healthy cervical canal, causing an acute endometritis, and subsequently by direct extension along the mucous membrane of the genital tract inflammatory conditions of the Fallopian tubes, ovaries, and peritoneum. It probably always gains entrance to the uterine cavity through the cervix. In the uterus it generally limits its ravages to the endometrium, although it apparently penetrates in a small number of cases into the muscular structure of the uterus, causing a metritis and abscess formation. This is in accordance with the views of Wertheim, who found the microbe in the stroma of the uterine mucosa, and of Madlener, who found it in the uterine muscle. The case of mine would point to the same abscess formation in the uterine muscle. The acute purulent endometritis which it causes after a time becomes chronic or heals. From the uterine cavity it frequently extends along the mucosa, and is the cause of most cases of pyosalpinx, pelvic adhesions, pelvic encysted peritonitis, of circumscribed pelvic abscess, ovarian abscess, and probably of many cases of hydrosalpinx. It can, from the uterine cavity, get into the blood-current and thus cause a systemic gonorrhœal infection. It apparently lives but a short time in the abscesses which it causes, but can, probably, exist much longer in the mucous membrane of the uterus. It is noteworthy that in most cases of chronic gonorrhœal endometritis the micro-organism cannot be found by bacteriological examination. Sänger emphasized this fact and recently Broese and Schiller came to the same conclusion from the examination of 271 cases. Every one who has attempted to cultivate the gonococcus has noted the great difference in various cases with which the micro-organism grows. The fact that one cannot cultivate it, and does not find it in stained specimens, is not proof that it does not exist in a given case. Where the micro-organism occurs in very small numbers, Gram's stain, by which it is identified, is very unsatisfactory. Clinical signs point to its existence for long periods of time, and it may be given renewed vitality from time to time by a change in its nutrient media, as in the puerperium, operations on the uterine mucosa, etc. It appears to be more apt to invade the puerperal or menstruating uterus, and is more apt to be than is usually thought the cause of miscarriages. Interesting in this connection are the two cases previously mentioned, in both of which the women gave histories of an infection immediately following a miscarriage, and both of which proved to be infections by the gonococcus alone. Neumann has recently reported a case where he examined a woman who had a gonorrhœal infection, and in whose decidua he found the gonococcus. Maslowsky also has recently reported a most interesting case, where a premature labor was caused by an "Endometritis decidualis interstitialis gonorrhoica." He found the gonococci in the decidua vera, which was infiltrated with small round cells. Fehling, Winckel, Krönig, and other authors believe this micro-organism to be a fruitful cause of miscarriage. It probably does not, by its presence, favor the entrance of other bacteria into the uterus, indeed, Menge and Wertheim believe that it will not tolerate other bacteria in the same field with it. In my seven cases it was not accompanied by other bacteria, nor in the cases which gave a gonorrhœal history were other micro-organisms found. It may be the cause of a pyometra. It is comparatively harmless to the peritoneum, for, although where it is being constantly poured into the peritoneal cavity, it always gives rise to a localized and perhaps, occasionally, to a general peritonitis, I do not find a well-authenticated case of death due to a gonorrhœal peritonitis. In one of the cases reported here, and in several occurring at various times in the clinic, where gonorrhœal pus was found free in the peritoneal cavity, after the removal of the pus and its source, the women recovered without any greater rise of temperature than one would expect in a clean case. In many of the cases of myomata, with inflammatory conditions of the appendages, this micro-organism is, probably, responsible for the inflammation. One of our cases, in which the gonococcus was found, was a case of myoma uteri.

The streptococcus pyogenes was found but once. This case was a negro woman with a large sloughing submucous uterine myoma. She entered the Hospital in an extremely weak condition—pulse 136, temperature 102°–104° F.—and died during the operation for removal of the myomatous uterus. The streptococcus, along with an unidentified bacillus, was found in the uterine cavity. There was undoubtedly a systemic infection by the streptococcus, although as no autopsy could be obtained this could not be proven. In this case the infection evidently occurred through the vagina, due to the following conditions: An open cervical canal due to the encroachment of the myoma, and to the uterus, cervix and vagina being filled with decomposing blood and necrotic myomatous material. Thus by overcoming the protective functions of the cervical canal and vagina, and by furnishing the bacteria with suitable nutrient media, this micro-organism which cannot under ordinary circumstances invade the uterus, found its way in and with a fatal result. This case corresponds entirely with the views of Menge and Krönig and with a case reported by Dr. Maurice H. Richardson in the *Boston Medical and Surgical Journal*, September, 1893, where a woman who had a facial erysipelas, and who was bleeding from a submucous myoma, died of a streptococcic peritonitis due to the invasion of the bacteria most probably through the genital tract. The streptococcus is of especial importance in puerperal infections but can, as we have seen above, cause infection in other conditions of the uterus, as in cases of myomata, carcinomata, necrotic polypi, and of course in operations upon the uterus, criminal abortions, etc. It is,

perhaps, in puerperal conditions nearly always introduced into the uterus by external agents, but can, as proven by Krönig's statistics, find its way into the puerperal uterus by growing in where no vaginal examinations have been made. In these cases it probably exists on the skin, clothing, etc., and finds in the vagina and cervix the suitable conditions for its extension. From the uterus it can gain entrance into the general organism through the lymphatics and the blood-vessels. In cases which do not run a rapidly fatal course, dense pelvic exudates in the connective tissue of the pelvis, filling the whole or part of the pelvis, and containing frequently small abscesses, are characteristic of a streptococcic uterine infection. This micro-organism may enter the peritoneal cavity along the lumen of the Fallopian tubes, although the more common route of invasion seems to be by way of the lymphatics, thrombosed vessels and abscess formation in the uterine walls. It produces frequently a systemic infection. Pyosalpinx is not usually the result of a streptococcus infection. In the normal non-puerperal uterus the streptococcus probably cannot gain entrance into its cavity without the aid of external agents.

The bacillus of tuberculosis was found by histological examination to be the cause of the endometritis in two of the 31 cases, nearly 6.5 per cent. In these two cases no tuberculous processes were found in the Fallopian tubes, and in another case the hysterectomy was performed for tuberculosis of the tubes, when the endometrium of the uterus was free from disease. These two cases would seem to show that primary tuberculosis of the endometrium may occur, the bacteria gaining entrance through the vagina and cervix. Most writers believe this to be the case. Most cases of tuberculosis of the endometrium are, however, secondary to processes in the tubes, and this as secondary to tuberculosis in other parts of the body. Tuberculosis of the endometrium seems to stop suddenly at the internal os, and pyometra frequently results as a product of tubercular endometritis.

The staphylococcus pyogenes aureus was found once, and the staphylococcus pyogenes albus twice, in the uterine cavity. The former was found in a pyometra along with an unidentified bacillus in a case of carcinoma of the cervix. The woman gave no evidence of a general infection by this micro-organism. The staphylococcus albus was found once following the removal of a submucous myoma where, after five or six days, the woman's temperature rising to 104° quite suddenly, a bacteriological examination was made by means of Döderlein's tube, and the staphylococcus was found both in cultures and on slides, together with an unidentified bacillus. In the second case the micro-organism was evidently carried in by instruments. Here the woman was curetted before removing the uterus. The micro-organism was found by means of cultures in small numbers in the uterine cavity, while the pus from the pyosalpinx was sterile. The staphylococcus pyogenes like the streptococcus can invade the cavity of the uterus probably only when the protective properties of the vagina and cervix are overcome, as in cases of carcinomata, myomata, etc., or when carried in by operative procedures. Once in the cavity of the uterus, if the endometrium is unwounded and under normal conditions, it soon disappears; but if the mucosa is wounded, or there is dead nutrient material there, it causes suppurative processes. It probably causes miscarriages by producing a deciduitis, as in a case reported by Neumann, or it may cause a general systemic infection, as in Strünckman's case. It is more rarely found in the uterine cavity than the gonococcus and streptococcus, and probably than the bacillus of tuberculosis.

The other bacteria found were unidentified and were, probably, saprophytes. One was found in the streptococcus case, two in cases of pyometra, once in combination with the staphylococcus pyogenes aureus, and one in the case of submucous myoma along with the staphylococcus pyogenes albus.

In looking at our cases from a clinical standpoint we find a result that may not be uninteresting. Making a diagnosis as to the mode of infection from the history of the case, coupled with the bacteriological examination, we find that of the 53 cases showing inflammatory changes, 26 were, probably, of gonorrhœal origin, 12 of puerperal origin, 3 due to tuberculosis, 4 to myomata or carcinomata, 4 to previous operations, and 2 unclassified. Some of the cases giving a history of puerperal infection undoubtedly owed their origin to the gonococcus. In our cases, therefore, the gonococcus was the probable cause of infection in more than one-half of them.

A few interesting points may be gained from the table. In two cases there was a hydrosalpinx and pyosalpinx combined in the same patient. Most writers think that pyosalpinx is due to bacteria, and many contend that bacteria have nothing to do with hydrosalpinx, and that hydrosalpinx is never the result of a purulent salpingitis. Our two cases would point to one and the same cause for both conditions. We see further that in four cases of hydrosalpinx, three of pyosalpinx, and two of ovarian abscess, there was, on histological examination, a normal uterine mucosa, *i. e.* no infiltration with small round cells, or polymorphonuclear leucocytes. There are only two explanations for this: one, that the infection did not occur *via* the uterine cavity, and the other that the preëxisting endometritis had healed. The latter is, in most cases, the most plausible explanation. We see cases of healed salpingitis also, hence it is more than probable that hydrosalpinx is frequently the end product of a suppurative salpingitis. Three deaths occurred, and it is instructive to investigate the causes: one, the streptococcus case was in a desperate condition when operated upon, and died on the table. The second died as the result of an intestinal perforation and the following peritonitis. The sigmoid flexure of the colon was injured during the operation and was sutured. This suturing gave way, and with a fatal result. The third was the result of an infection with the staphylococcus pyogenes albus, and streptococcus pyogenes secondary to drainage in a case, probably, originally gonorrhœal. The cultures and stained preparations at the time of operation showed no bacteria. Drainage was through the vagina, and also through the abdominal wound. The staphylococcus infection occurred through the vagina, as proven by bacteriological examination before death. Both micro-organisms were found in the peritoneal cavity at autopsy. Death then in one of the two fatal cases possible to have been avoided was due to drainage. In the other case drainage

would possibly have saved the life of the patient, but was not indicated at the time, as the bowel was supposedly well sutured.

Let us see how our results correspond with the results obtained by the various investigators. Winter was among the first to examine bacteriologically the cavity of the uterus. As a result of his investigations he came to the conclusion that "the healthy body cavity of the uterus contains no bacteria." His work was done upon uteri which had been removed for myomata, or upon those removed by panhysterectomy. He did not examine the mucosæ of these uteri histologically. Brandt, in cases of symptomatic endometritis, found in 30 per cent. of all his cases pyogenic bacteria, and in the 25 cases examined only 3 were free from bacteria. Péraire, who also worked with cases of endometritis, found practically the same thing. Pfannenstiel, in both interstitial and glandular chronic endometritis, found no bacteria. Bumm states that in the chronic glandular and interstitial endometritis of non-pregnant women bacteria are in most cases not present, but that in a small number of cases one finds bacteria, which he regards as only an *accidental* accompaniment of these conditions, and which can change according to the character of the secretion. Wertheim says that the gonorrhœal infection of the uterus causes always a purulent catarrh which, when it becomes chronic, can produce a hypertrophy and hyperplasia of the uterine glands, and that the inflammation may extend to the myometrium. Gottschalk and Immerswahr found in cases of endometritis that bacteria were present in 65 per cent. of the uteri, and found frequently the staphylococcus pyogenes. They thought that the presence of the gonococcus predisposes to the subsequent invasion of the staphylococcus. Madlener went further than Wertheim, who had found the gonococcus in the stroma of the uterine mucosa, and found this micro-organism in the uterine muscle. He says that the gonococcus of Neisser has the faculty of penetrating the musculature of the uterus from the endometrium, and thus cause inflammation. Bumm, however, states that he examined Madlener's preparations and was not convinced that gonococci were present. Boije found bacteria present in 19 of 30 cases, and came to the conclusion that bacteria are the causes of interstitial endometritis, but not of glandular. Menge examined the body cavity of 119 uteri which had been removed for a variety of causes. Thirty-nine of these cases showed round-cell infiltration of the uterine mucosa, and 11 of the 39 cases were in carcinoma of the cervix. As a result of his investigations he comes to the conclusion that neither in the secretions nor in the tissue of the mucosa of the cavity of the corpus uteri, in cases showing no endometritis or only the glandular form, do bacteria exist which we can cultivate. In his 119 cases he found bacteria only 11 times. One case was that of a submucous necrotic myoma; two were cases of gonorrhœa; two, of tuberculosis of the endometrium; one, an unknown bacillus in an acute case; and the remaining five were in cases of pyometra. Opitz examined 10 cases and found all free from bacteria. Kollman reports a case of a myomatous uterus, in which the mucosa showed no inflammatory changes where he found bacteria present in the cavity. These were not identified. Warbasse, in 17 cases of chronic endometritis, found bacteria present in 5 of them. He concluded, however, that the micro-organisms were not the cause of the endometritis, and that it is no more necessary to look for a bacterial origin of chronic endometritis than in inflammation of other glandular organs.

In looking over the literature of the subject we find that the following bacteria have been found in the uterine cavity in its various inflammatory conditions, *viz.* gonococcus of Neisser, streptococcus pyogenes, staphylococcus pyogenes aureus, albus and epidermidis albus, bacillus of tuberculosis, bacillus coli communis, bacillus ærogenes capsulatus, bacillus of tetanus, bacillus typhosus, diplococcus lanceolatus, and many saprophytic and unidentified bacteria. All of these bacteria have been found in the puerperal uterus. In the non-pregnant and non-puerperal uterus the only micro-organisms reported to have been found are the gonococcus, the streptococcus pyogenes, the staphylococcus pyogenes, the tubercle bacillus and saprophytic bacteria. The cavity of the corpus uteri of both the pregnant and non-pregnant woman under normal conditions is free from bactera. The boundary line between this bacteria-containing and bacteria-free zone is the external os uteri. The only bacteria which can invade the cavity of the uterus through the external os without the help of external agencies, and under normal conditions are the gonococcus of Neisser and the bacillus of tuberculosis. Nearly all of the best-known investigators are agreed upon this view. Upon the causes of inflammation of the mucosa of the uterus and the bacteria which may be found there in cases of endometritis there is not such a unanimity of opinion. It is of vital importance to the surgeon to know if the streptococcus pyogenes, the staphylococcus pyogenes or other pathogenic bacteria do exist in the uterine cavity, and if so, under what conditions he may expect to find them, and what may be done to guard against carrying these micro-organisms into the peritoneal cavity or exposed wound surfaces. In the class of cases previously mentioned, where the protective functions of the vagina and cervix are totally, or in a measure, lost by means of a prolapsus, or very much relaxed vaginal outlet, an open cervical canal, or destruction of the cervix by carcinoma, where the cervix and vagina are filled with dead nutrient material as necrotic placental remains, carcinomata, sloughing myomata or polypi, both the pathogenic and saprophytic bacteria are liable to be encountered. Following also, of course, recent operative procedures upon the vagina or uterus, an acute wound infection may exist and thus infect the peritoneum of the patient upon whom a laparotomy is subsequently done. In puerperal sepsis, of course, also this danger exists. The gonococcus will also be frequently encountered in inflammatory cases, but may be disregarded so far as operative procedures are concerned.

In uncomplicated cases of hystero-myomectomy, hysterectomy for inflammatory cases, or ovarian tumors, operations for extra-uterine pregnancies, and in all such cases where the vagina and cervix are normal, except, probably, for the invasion of the gonococcus, *the safest route so far as infection is concerned is the abdominal.*

In operations for carcinomata, especially where the cervix is necrosed, in submucous myomata, especially if the tumor

encroaches on the cervix, and in similar cases of polypi, etc., in puerperal cases upon whom a hysterectomy is performed, and in circumscribed pelvic abscesses which are liable to be secondarily infected from the intestine, *the safest route with regard to infection is the vaginal.*

As the external genitalia and the surrounding parts are even more liable to contain pathogenic bacteria than the abdominal wall, the cleansing and disinfection of these parts is as imperative as the cleansing of the abdomen preparatory to operation.

Drainage through the vaginal vault in cases of laparotomy unless imperative to arrest hæmorrhage, or in cases of wounded intestine where the suturing is unsatisfactory, is almost as much to be deprecated as drainage through the abdominal wall. The vaginal vault should be, when possible, left intact.

In conclusion, I wish to thank Drs. Kelly, Russell, Clark and Ramsay for their aid and encouragement in my work, and Drs. Cullen and Hurdon for the pathological reports of the cases.

Total number of cases examined bacteriologically	68
No. of cases of an inflammatory nature	53
No. of cases of uterine myomata	24
No. of cases of carcinoma of cervix uteri	3
No. of cases of probable puerperal infection as shown by the history	12
No. of cases of *probable* gonorrhœal infection as shown by the the history	19
No. of cases of *positive* gonorrhœal infection	7
No. of cases where endometrium examined histologically	51
No. of cases of endometritis with small round-cell infiltration only	12
No. of cases of endometritis with small round-cell and polymorphonuclear cell infiltration	19
No. of cases where there were was no endometritis	18
No. of cases of pyometra due to gonococcus	1
staphylococcus and saprophytes	1
saprophytes only	2
No. of cases of abscess in uterine wall (muscle)	3
No. of cases of tubercular endometritis	2
No. of cases where the streptococcus was found	1
No. of cases where the staphylococcus was found albus	2
aureus	1
No. of cases where unknown bacteria were found	4
No. of cases of myoma uteri accompanied by endometritis or inflamed adnexa	9
No. of cases of myoma uteri where the endometrium showed no inflammatory change	11
No. of cases of pyosalpinx	24
No. of cases of hydrosalpinx	9
No. of cases of pelvic adhesions only	9
No. of cases of circumscribed pelvic abscess	3
No. of cases of ovarian abscess	5
No. of cases of hæmatosalpinx	2
No. of cases of hydrosalpinx of one tube and pyosalpinx of the other	2
No. of cases of hydrosalpinx with no endometritis	4
No. of cases of pyosalpinx with no endometritis	3
No. of cases of ovarian abscess with no endometritis	2
No. of cases of infection through the cervical canal due to myomata	2
No. of cases of infection through the cervical canal due to carcinoma of cervix uteri	2
No. of cases of infection through the cervical canal due to operation	1
No. of cases in which inflammatory changes in the uterine adnexa were due to previous operation	3
No. of cases of *probable* gonorrhœal infection where endometritis was found	12
No. of cases of *probable* puerperal infection where endometritis was found	6
No. of deaths due to drainage	1
intestinal perforation	1
streptococci infection	1

Bibliography.

Audion: Tuberculose primitive des organes génitaux chez une enfant de 13 ans. Gazette Hebdom. de Méd. et de Chir., No. 19, 217–220.

Boije: Beitrag zur Aetiologie und zur Natur der Endometritis. Centralblatt für Gynäkologie, 1896, 20, S. 271.

Bumm: Histologische Untersuchungen über die puerperale Endometritis. Archiv für Gynäkologie, Bd XL, 1891.

Bumm: Ueber Diphtherie in Kindbettfieber. Zeitschr. für Geb. und Gynäkologie, XXXVIII, 1895, 126–136.

Bumm: Zur Aetiologie der Endometritis. Verhandlungen der deutschen Gesellsch. für Gynäkologie, 1895—VI. Kongress in Wien, S. 195.

Bumm: Zur Frankfurter Gonorrhoe Debatte. Centralblatt für Gynäkologie, 1896, S. 1257.

Broese und Schiller: Zur Diagnose der weiblichen Gonorrhoe. Berliner klinische Wochenschr., N. 29, 1898.

Bulius: Ueber Endometritis Decidua polyposa et tuberosa. Münch. med. Wochenschr., 1896, XLIII, S. 537.

Burr: Gonorrhœa as a Factor in Puerperal Fever. The Journal of the Amer. Med. Assoc., Sept. 3rd, 1898.

Cullen: Tuberculosis of the Endometrium. The Johns Hopkins Hospital Reports, Vol. IV, Nos. 7-8.

Dobbin: A case of Puerperal Infection, in which the Bacillus Typhosus was found in the Uterus. Amer. Jour. Obstetics, Vol. XXXVIII, No. 2, 1898.

Donat: Archiv für Gynäkologie, Bd. 24, S. 281.

Gottschalk und Immenwahr: Ueber die im weiblichen Genitalkanale vorkommenden Bakterien in ihrer Beziehung zur Endometritis. Archiv für Gynäkologie, 1896, 50, S. 165.

Hirst: A Text-book of Obstetrics, 1898.

Hofbauer: Ueber primäre Uterus-Tuberculose. Archiv für Gynäkologie, LVI, 395–400, 1898.

Krönig: Bakteriologie des weiblichen Genitalkanales, Teil 2.

Kollman: Ein interessanter Bacterienbefund in einem wegen Myomen extirpirten Uterus. Münch. med. Wochensch., 1898, XLV, 140-142.

Lewers: Cancerous Uterus with Pyometra. Trans. Obst. Soc. London, 1896, XXXVIII, 14-16.

Lindenthal: Ueber bacteriologische Befunde bei Tympania Uteri. Aerzt. Centr. Anz., Wien., 1898, X, 35.

Madlener: Ueber Metritis Gonorrhoica. Centralblatt für Gynäkologie, 1895, S. 1313.

Maslowsky: Zur Aetiologie der vorzeitigen Ablösung der Placenta vom normalen Sitz. Monatschr. f. Geb. und Gynäk., Bd. IV, 1896, pp. 212-218.

Menge: Bakteriologie des weiblichen Genitalkanales, Teil I.

Neumann: Ueber puerperale Uterus Gonorrhoe. Monatschr. für Geburtsh. und Gynäk., 1896, 14, pp. 104-116.

Noble: Four Cases of Abscess of the Uterus. Medical Record, 1897, Dec. 4th.

Opitz: Bakteriologische Untersuchungen. Centralbl. f. Gynäk., 1897, XXI, 1505-1515.

Osler: Practice of Medicine, 1898, pp. 255-257.

Richardson: A Case of General Streptococcic Infection of the Peritoneum following a Facial Erysipelas. Boston Med. and Surg. Journal, Sept. 3rd, 1893.

v. Rosthorn: Ueber die Folgen der gonorrhoischen Infektion bei der Frau. Prager med. Wochenschr., XVII, 2-3, 1892.

Rubeska: Beitrag zum Tetanas puerperalis. Archiv für Gynäk., 1897, LIV, 1–13.

Sänger: Die gonorrhoische Infektion beim Weibe. Schmidt's Jahrbücher, CCXXIII, 1889.

Singer: Thrombose und Emboli im Wochenbett mit besonderer Berücksichtigung der gonorrhoischen Infektion. Archiv f. Gynäk., 1898, LVI, 218-263.

Strünckman: Zur Bakteriologie der puerperal Infektion, 1898, Berlin, S. Karger. Centralblatt für Gyn., No. 36, 1898.

Welch: Dennis' System of Surgery, General Bacteriology of Surgical Infections.

Warbasse: Original Studies in the Bacteriology of Uterine Scrapings. American Jour. of Med. Sciences, Phil., 1898, N. S. LXV, 184-188.

Williams, J. W.: Forty cases of Fever in the Puerperal Period with a Bacteriological Examination of the Uterine Contents. Amer. Jour. Obst., 1898, XXXVII, 657–660.

Williams, J. W.: Tuberculosis of the Female Generative Organs. The Johns Hopkins Hosp. Reports, 1892, Vol. III.

Wertheim: Die ascendirende Gonorrhoe beim Weibe. Archiv f. Gyn., Bd. XII, 1891, Heft I.

Wertheim: Ueber Uterus Gonorrhoe Verhandlungen der VI. Versammlung der deutsch. Gesell. für Gynäk. in Wien, 1895, S. 198.

Wertheim: Zur Frankfurter Gonorrhoe Debatte. Centralblatt f. Gynäk., 1896, S. 1209.

v. Winckel: Referat über Aetiologie und Symptologie der Endometritis. Verhandlung d. deutsch. Gesell. f. Gynäk., VI. Kongress, S. 87.

Winter: Die Mikroorganismen in Genitalkanal der gesunden Frau. Zeitschr. f. Geburtsh. und Gynäk., Bd. XIV, 1888.

THE PRESENCE OF FOREIGN BODIES IN THE VERMIFORM APPENDIX, WITH ESPECIAL REFERENCE TO POINTED BODIES.

BY JAMES F. MITCHELL, M. D.

(*From the Gynæcological Department of the Johns Hopkins Hospital.*)

The suggestion of a pin being the cause of an appendicular abscess as brought out in the history of a patient in the Gynæcological Wards of the Johns Hopkins Hospital has led, with Dr. Kelly's encouragement, to this inquiry, as to foreign bodies in general as a cause of appendicitis, and especially pointed bodies.

The patient, a girl aged twenty, was admitted to the service of Dr. Kelly with a sinus in the abdominal wall at the right iliac fossa. It was stated that, when about six or seven years of age, she had pain in the right iliac region followed by an abscess developing sufficiently to be opened in forty-eight hours. The wound was dressed every day thereafter, and some time later a pin was found in the discharge from the wound and the whole trouble was attributed to that. There was no further trouble until about four years ago, since when she has had repeated attacks of appendicitis more or less typical.

As to the frequency with which foreign bodies other than fæcal masses are found in the vermiform appendix, our opinions have changed greatly in the last ten years; at one time the presence of a foreign body was thought essential to an appendicitis, and the classical orange, date, or cherry seed were often described. Undoubtedly many of them, so eagerly sought, were nothing more than fæcal concretions which are likely to assume these shapes, and unless carefully examined easily deceive the observer. From this extreme the other has now been reached. Many writers at the present day go so far as to state that foreign bodies are never found as the cause of appendicitis, and this attitude would seem to find some justification in the following facts.

Fitz,* in 1886, collected 152 cases of perforative appendicitis, and found 12 per cent. of foreign bodies with 47 per cent. of fæcal concretions while Hawkins,† in 1895, in 67 fatal cases did not find a single foreign body. In 250 cases of appendicitis in the Johns Hopkins Hospital in the past ten years, there has been only one foreign body—a segment of tapeworm.

With this object in view I have collected 1400 cases from various sources in the last ten years, and find about 7 per cent. of true foreign bodies; while in 700 of these cases, in which a definite statement was made as to the nature of the foreign body, there were 45 per cent. of fæcal concretions. The older statistics invariably give a higher percentage of foreign bodies.

While so many accounts are evidently untrustworthy because of lack of careful examination, the undoubted occurrence of many queer and interesting objects as shot, pins, worms, gallstones, a tooth, or a piece of bone, has been recorded; and even the discarded grape seed or cherry stone is occasionally seen. Fenger‡ had a case in which two grape seeds and an oat husk were found, and Welch once met with a date seed. Osler,§ in ten years' experience in Montreal, found foreign bodies only

* Fitz: Transactions of the Association of American Physicians, 1886, I, 110.

† Hawkins: On Diseases of the Vermiform Appendix, London, 1895.

‡ Fenger: American Journal of Obstetrics, 1893, XXVIII, 168.

§ Osler: Principles and Practice of Medicine, 1898, 520.

twice; in one instance five apple pips, and in another eight snipe shot. Stone,* of Omaha, and Ransohoff,* of Cincinnati, each removed an appendix containing a bullet (Fig. 6) as the exciting cause. A case is reported by Holmes,† in which 122 robin shot were present in the appendix of an old man dead of pneumothorax, who, during life, had had no symptoms referable to the appendix; but who, it is stated, was very fond of game. Interesting in connection with this is the following observation in the Mémoires de l'Académie Royale de Chirurgie‡ in 1743. "One notices sometimes in opening the bodies of persons who, during life, have eaten a great deal of game that there is collected in the intestines, and especially in the cæcal appendix, a great quantity of shot, without those persons having had the least inconvenience."

Gall-stones are not infrequent and cases are cited by Gibbons,§ Nelson‖ and Ulloa y Giralt.¶ Fæcal concretions may so closely resemble gall-stones that it is impossible to distinguish between them except by chemical analysis. For the sake of exactness too much stress cannot be laid on this. A specimen kindly loaned by Dr. Rogers, of Memphis (Fig. 4), well illustrates this. The patient, a man aged twenty-two, had an attack of hepatic colic, with intense pain over region of gall-bladder, jaundice, vomiting, fever, etc. His trouble subsided and then after a few days symptoms of appendicitis appeared, which likewise subsided, leaving slight tenderness in the right iliac fossa. On examination three small nodules could be felt at the site of the appendix. Operation revealed an appendix distended with three bodies looking exactly like gall-stones, and such Dr. Rogers very rightly supposed them to be. Chemical examination by Dr. Thomas R. Brown, however, showed that they contained no cholesterin and no bile pigments nor salts, but were made up mostly of organic matter with carbonates and phosphates of calcium and magnesium.

One class of foreign bodies, however, far more common and more important than any of these, may be grouped together as pointed bodies. The only explanation that can be offered for their presence is in their shape, which allows them to become engaged in the cæcal opening of the appendix more readily.

A not uncommon occupant of the appendix is a lumbricoid worm. Numerous cases are recorded. One of the earliest of these is that of Blackadder** in 1824. A man in apparent good health was seized with sudden abdominal pain, so intense that he fell to the ground and died in less than four hours. At autopsy nothing was found except that into the appendix which was remarkably increased in length and thickness and felt like a firm cord, a large lumbricus had forced its way until only an inch of its tail projected into the cæcum. There were no other lumbrici in the alimentary canal.

Dr. C. F. Brower,* of Virginia, possesses the specimen, of which a drawing is shown (Fig. 1). The patient, a child of twelve years, presented symptoms of a mild attack of appendicitis. Dr. Brower operated 30 hours after onset of symptoms, removing the appendix with a portion of adherent omentum. The worm, being still in the appendix, was divided by the scissors and half of it then withdrawn from the cæcum. The appendix was gangrenous for an inch and a half at its distal end, and at one point was on the verge of perforation. Recovery was uneventful.

The only foreign body observed in this Hospital in 250 cases was a segment of tapeworm, seen in a fatal case of appendicitis reported by Robb.†

Warren Coleman,‡ in a man of sixty-seven, dead of nephritis and pneumonia, found in the dilated appendix a piece of bone five-eighths of an inch long and a quarter of an inch at its broadest part. It had entered blunt end foremost and was enveloped in mucus, completely filling the dilated tip. The thickened walls showed evidence of its presence for a long time, but externally there were no signs of inflammation. This case and that in which the appendix contained 122 shot, together with several that follow, show that, while generally causing very rapidly progressive inflammation, even large and rough foreign bodies can be present in the appendix and give no symptoms at all or can lead to chronic or recurrent appendicitis. Murphy§ also had an acute appendicitis, in which the offender was an enterolith having a spicule of bone as its nucleus. Thompson‖ reports a case in which a bone was present. Nathaniel Ward,¶ in 1855, had a patient who died after an acute illness of seven days. At autopsy it was seen that a small worn-down bristle from a tooth brush, a third of an inch long, had ulcerated through the base of the appendix and had given rise to purulent peritonitis. Dr. Schooler,** of Des Moines, removed an appendix containing a wisp of broom and another in which there was a bristle, and Abbe** recently had one containing a piece of corn husk.

In the Gynæcological Laboratory of the Johns Hopkins Hospital is a specimen (Fig. 3) which was successfully removed by Dr. W. E. Ashton†† from a woman forty-eight years old. She gave a history of abdominal pain, lasting through three years, and referred to the uterus which was curetted and the cervix amputated. The pain continued and increased, but did not become localized. Examination revealed nothing except a slight general soreness over the entire abdomen. An explor-

* Stone and Ransohoff: Personal communication.

† Holmes: New England Quarterly Journal of Medicine and Surgery, Boston, 1882-3, I, 257.

‡ Hevin: Mémoires de l'Académie Royale de Chirurgie, 1743, I, 460.

§ Gibbons: West. Lancet, San Francisco, 1873, II, 113.

‖ Nelson: British American Journal of Medicine and Physical Science, Montreal, 1846-7, II, 257.

¶ Ulloa y Giralt: Revista mensual médico-quirúrgica de Neuva-York, 1878, I, 28.

** Blackadder: Edinburgh Medical and Surgical Journal, 1824, XXII, 18.

* Dr. Brower himself expects to publish this case *in extenso* at a later date.

† Robb: Johns Hopkins Hospital Bulletin, 1892, III, 23.

‡ Coleman: Medical Record, N. Y., 1895, XLVIII, 639.

§ Murphy: Journal of the American Medical Association, Chicago, 1894, XXII, 302.

‖ Thompson: British Medical Journal, Sept. 23d, 1892.

¶ Ward: Transactions of the Pathological Society of London, 1855, VI, 197.

** Schooler and Abbe: Personal communication.

†† Ashton: Medical Bulletin, Philadelphia, 1894, XVI, 85.

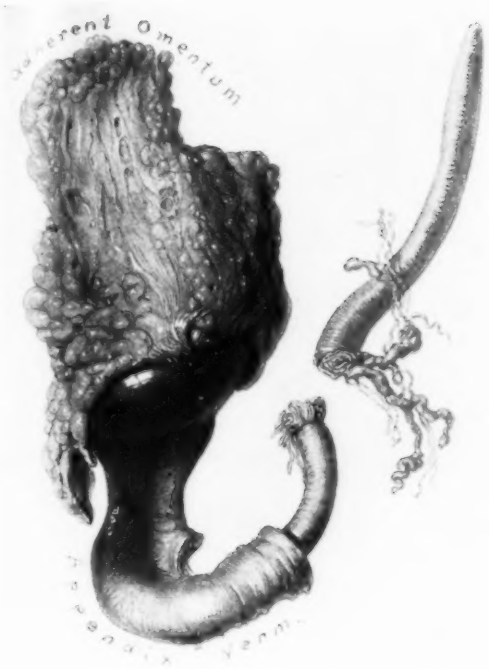


FIG. 1.—Appendix containing a round worm. Removed by Dr. C. F. Brower, Catharpin, Va. (By courtesy of Dr. Halsted.)

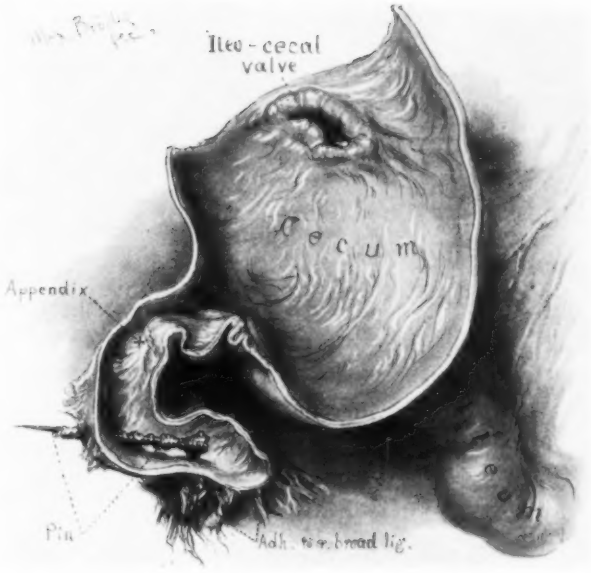


FIG. 2.—Appendix with pin perforating its wall. Removed by Dr. H. D. Rolleston, London, Eng. (Case 27.)

FIG. 3.—Appendix containing a fish fin. Removed by Dr. W. A. Ashton, Philadelphia.

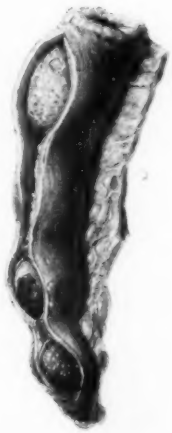


FIG. 4.—Appendix containing three supposed gall-stones. Removed by Dr. W. R. Rogers, Memphis, Tenn.

FIG. 5.—Fæcal concretion with pin as nucleus. Removed by Dr. Francis H. Markoe, New York. (Case 10.)

FIG. 6.—Fæcal concretion with bullet as nucleus. Removed by Dr. Joseph Ransohoff, Cincinnati, O.

atory abdominal incision was made, and the appendix, which was adherent to the brim of the pelvis, was removed. In it was the fin of a fish which, through pressure, had caused circulatory changes and ulceration.

PINS IN THE APPENDIX.

Conspicuous among pointed bodies and occurring with apparently greater frequency than any others are pins. Abbe,* in his large experience, has met with only two foreign bodies, and one of these a pin. Roswell Park† and McBurney‡ had each two cases, and numerous instances are to be found scattered through the literature. The earliest probable case we have encountered is described by Ruysch,§ of Amsterdam, in 1691. A young girl had swallowed a pin. Some time afterwards a hard inflammatory tumor appeared in the groin accompanied by fever and acute pain. Soothing applications having been used and suppuration induced, an incision was made in the tumor, and in the pus and fæcal matter evacuated was a rusty pin. ("Statim simul cum pure copioso acicula ærugino abducta prodit, non sine excrementorum alvinorum commixtione . . . . non est dubitandum, quin in principio, suborta inflammatione, intestinum, ab aciculæ mucrone læsum arctè connatum fuerit peritonæo.")

After a careful search we have collected twenty-eight other cases in which a pin was found in the appendix at operation or at autopsy, together with two instances in which a pin had perforated the cæcum.

In no single case has there been any knowledge of swallowing a pin and no explanation is offered for their presence.

Contrary to what might be expected, they occur more often in males than in females (males 17, females 9). Many are in of children under ten years of age; one in a boy of fifteen months; others in adults in various occupations and conditions of life.

One would naturally suppose that such a foreign body in the appendix would lead to rapid perforation; but, while this is generally the case, it is not always so. All types of appendicitis may result. Some give rise to only mild symptoms and may lead to chronic appendicitis (7 cases) with recurrent attacks, or with long-continued pain, or only a feeling of uneasiness in the right iliac region, which may last for months or years, and perhaps finally end in an abscess (Cases 14 and 15). Most often, however, there is rapid perforation and abscess formation following the first appearance of symptoms.

The pin may enter the appendix by its head or point. It is generally straight, lying in the lumen of the appendix with its long axis parallel to that of the appendix, and perforating with its point (Fig. 2). In one or two instances, however, it lay directly across the lumen and perforated with its head one wall, with its point the opposite. Dr. McBurney removed an appendix which contained two pins lying side by side and perforating the opposite walls of the appendix in this manner (Case 8).

On two occasions the pins have been found in appendices contained in hernial sacs.

The pin may be free from deposit, rusty or corroded. Usually, however, it is the nucleus of a fæcal concretion which covers the head and most of the shaft, leaving the point free. Such a body is shown in the accompanying cut (Fig. 5) from a case operated upon by Dr. Markoe (Case 10).

An interesting feature of this collection of cases is the frequent association of abscess of the liver, which was observed in seven of the twenty-eight.

From our investigation we can draw the following conclusions, supported by statistics:

Foreign bodies, at one time thought essential in appendicitis, are now known to play a much smaller rôle than that formerly accredited to them; and fæcal concretions are much more apt to be present as an exciting cause.

While many curious and unexpected things are occasionally found, the appendix nevertheless would seem to act especially as a trap for pointed bodies and for small heavy objects like shot or bullets.

Conspicuous among pointed bodies are pins, and their presence is by no means uncommon.

Those foreign bodies *of light weight*, like grape seeds and cherry stones, so popularly assigned as the cause of appendicitis, and against which we are forever being warned, are in reality exceptional, and their frequency is much overestimated on account of the close resemblance of fæcal concretions and the lack of careful examination of the bodies described.

The following cases, recorded in the literature and communicated privately, warrant the assertion that the pin is one of the commonest and at the same time the most dangerous of all foreign bodies.

CASES.

(1) *Mestivier* (1757): Jour. de Méd. Chir. Pharm., etc., 1759, X, 441.

A man, aged 45, presented himself with a large fluctuating tumor in the right side of abdomen near the umbilicus. It was opened and a pint of very foul pus evacuated. He died. At autopsy: "The cæcum presented nothing extraordinary. Here and there were gangrenous ulcers. Scarcely was the appendix opened, however, when there was found a large pin all encrusted and so eroded in places that the least force would have broken it."

Although the man had never mentioned swallowing a pin it was easy to conceive that it had long been shut up in the appendix, and by irritating the various coats had caused the trouble leading to death.

(2) *Parrot* (1855): Bull. Soc. anat. de Paris, 1855, 54.

Man, aged 24. Twelve years ago had pain in right inguinal region with the development of a tumor in the right iliac fossa. Eight years later the tumor made sudden progress. A year ago it was considerably increased and there were general symptoms and acute pains. An abscess opened and discharged considerable bloody pus. Patient was admitted with a fæcal fistula in lower right abdomen in which the probe encountered something hard. An incision was made and this body extracted with great difficulty. It proved to be an ordinary pin with the point free and otherwise enveloped in solid fæcal matter. The patient died with general peritonitis. Autopsy showed the fistula leading into a cavity into which opened the appendix.

* Abbe: Personal communication.

† Park: Medical Record, New York, 1895, XLVII, 345.

‡ McBurney: Personal communication.

§ Ruysch: Observationum Anatomico-Chirurgicarum, Amsterdam, 1691, Observatio LV, 71.

Patient did not remember swallowing a pin.

(3) *Joffroy* (1869): Bull. Soc. anat. de Paris, 1869, XLIV, 512.

Girl, aged 10. Admitted with pain in right groin, radiating through abdomen, diarrhœa and incessant vomiting. Two days later tumor in right flank, which disappeared in a few days. Later, multiple superficial abscesses. Death in two months.

Autopsy: Circumscribed abscess in right iliac fossa with a collection of pus. In the appendix was found a pin of large size which had entered head first and had penetrated with its point the appendix wall. The pin was surrounded by fæcal matter.

(4) *Payne* (1870): Trans. Path. Soc., London, 1870, XXI, 231.

Woman, aged 37. Illness of three weeks; headache; abdominal pain; tenderness; bowels regular; temperature 104°; delirium and death.

Autopsy: Lodged in the appendix was a medium-sized black pin, the head and three-quarters of shaft surrounded by a fæcal concretion making a mass an inch long. The bare point of the pin projected into the cæcum. The appendix walls were thickened but there were no signs of acute inflammation. No general peritonitis. Abscesses of liver and lungs.

(5) *Legg* (1875): St. Barth. Hosp. Rep., London, 1875, XI, 85.

Girl, age 5. History of bronchitis, measles and scarlet fever, the last followed by an abscess in right groin which was poulticed and opened spontaneously. Child was well for a time and then wasted. Abscess developed in epigastrium; was opened, discharged great deal of pus; healed. Twelve days later abdominal distention, vomiting, death.

Autopsy: Multiple abscesses among intestines. Abscesses of liver. Appendix adherent to cæcum was cut across and a black pin was noticed which apparently came out of the gut; rusty on its head and upper third. On dissecting out the appendix, a round hole the size of a split pea and black around its edges was found to open from the appendix into peritoneal cavity close to cæcum.

(6) *Whipham* (1879): Trans. Clin. Soc., Lond., 1879, XII, 58.

Boy, aged 18. Five months before admission had an illness of six weeks; pain in side and diarrhœa. Seven days before admission pain in right side, shooting to axilla; next day bent with pain; sixth day vomiting, diarrhœa, abdominal tenderness; no tumor.

Operation: Incision; drainage tube in chest.

Few days later acute abdominal symptoms and death.

Autopsy: Localized abscess in right iliac fossa extending to sacrum and bladder; purulent and fæcal contents. Free in abscess cavity was a pin an inch and a half long. The appendix, doubled on itself, was perforated at opposite points in the fold. Appendix adherent to cæcum with a perforation into cæcum.

(7) *Ashby* (1879): Lancet, London, 1879, II, 649.

Girl, aged 8. Four months' illness; type of appendicitis. Pain in right side; legs drawn up; temperature 105°. Death.

Autopsy: Large abscess of liver. Appendix contained a pin encrusted with phosphates and its point sticking through appendix wall. Near this spot was a ragged ulcer with its base adherent to parts around.

No history of swallowing pin.

(8) *McBurney*, New York (1888): (Personal communication to Dr. Kelly.)

Boy, aged 10. Patient for some time had had what appeared to be an inflamed irreducible right inguinal hernia, the contents of which were thought to be omentum. At operation the contents were found to be a much-inflamed and thickened bulbous appendix, the enlarged distal end being about an inch in diameter. In this mass, the points piercing one side and the heads the other, were two black pins which lay close together. The appendix was amputated and the case finished as one of hernia. Recovery.

(9) *Baker* (1889): Brit. Med. Jour., 1889, 1347.

Man, with symptoms of intestinal obstruction and swelling in right iliac fossa.

Operation: Median incision and evacuation of fœtid pus. Six weeks later peritonitis and death.

Autopsy: A pin was found with its point protruding through the appendix, and its head buried in a mass of fæcal matter which could not be removed.

(10) *Francis N. Markoe*, New York (1892): (Personal communication to Dr. Kelly.)

Boy, aged 4. Child always well till four months ago. At that time had what his physician said was an acute attack of appendicitis, and an abscess was formed in the right iliac fossa, which opened spontaneously and left a discharging sinus. On admission there was found a sinus with several openings just below and to the inner side of the anterior superior spine. A probe passed an inch and a half downwards and backwards. Discharge had a fæcal odor.

Operation: Sinus curetted. No result. A few weeks later it was laid open, and a pin with a concretion about its middle was removed. No further attempt was made to explore the region. The appendix was not seen. After a short time the wound healed.

(11) *Shoemaker* (1892): Trans. Coll. Phys., Phila., 1892, 3 s., XIV, 214.

Male, aged 18. Illness of twelve days; chill; pain in right side; constipation; fæcal vomiting and subnormal temperature; abdomen tense and œdematous; no tumor; no jaundice.

Operation: Incision in the right semilunar line. General purulent peritonitis. Death next day.

Autopsy: General peritonitis. Ruptured hepatic abscess. Appendix not ruptured, but gangrenous and containing a common pin head downward.

(12) *Bell* (1894): Canada Med. Rec., November, 1894.

Boy, aged 6. Usual signs and symptoms of appendicitis. Two days' illness. Operation and recovery. On opening the appendix a pin was found lying transversely in its lumen, near the tip. The head of the pin had ulcerated through the wall of the appendix, and the point had nearly perforated the opposite side, and at this point the appendix was strengthened by a mass of adherent omentum.

(13) *Willard and Lloyd* (1894): Trans. Path. Soc. of Phila., 1894, XVII, 40.

Boy, aged 9. While under treatment for spinal caries developed acute abdominal symptoms; vomiting, abdominal pain and irregular temperature; legs drawn up; anxious expression.

Operation: Sixth day. Incision and drainage of abdominal abscess; collapse; death.

Autopsy: General peritonitis, with adhesions. Multiple abscesses of liver. Appendix perforated at a point near its base. Around this perforation were signs of inflammation. On laying appendix open it was found to contain a large black pin with its head toward the cul-de-sac, and its point projecting from the opening.

(14) *Park:* (1895): Med. Rec., N. Y., 1895, XLVII, 345.

Man, age 32. History of indefinite discomfort in right iliac fossa for five years, with acute attack of one week's duration.

Operation: Appendectomy. Extensive abscess. In appendix was a fæcal concretion three-quarters of an inch long and of the diameter of a lead pencil. Imbedded in it was a common pin with the point protruding. Drainage; recovery. Patient denied all knowledge of having swallowed a pin.

(15) *Park* (1895): Med. Rec., N. Y., 1895, XLVII, 345.

Girl, aged 15. Vague and indefinite discomfort for months in right iliac fossa. Finally symptoms of acute appendicitis with temperature and abdominal rigidity.

Operation: Incision parallel to Poupart's ligament. Three or four ounces of foul pus. Appendix not found, but a pin in the pus; drainage; recovery.

(16) *McPhedran and Craven* (1895): Canad. Pract., 1895, XX, 180.

Male, aged 21. Pain in abdomen and chest; temperature 103°; chills almost daily for six weeks; temperature sometimes reaching

106.4°. Aspiration of chest; no pus. Later, pus in ankle-joint. Four months later coughed up six ounces of pus. Pyuria. Death.

Autopsy: Small abscess of liver communicating with abscess in right pleural cavity, and this with a bronchus. Other liver abscesses. Appendix thickened and dilated. About its middle was a distinct cicatricial contraction and in the dilated extremity beyond lay a large-sized common pin. It was bent at an obtuse angle and its tip was imbedded for an eighth of an inch in the appendix wall. The pin was largely covered with a layer of calcareous matter laid down in a regular coat.

(17) *Colmer* (1895): Lancet, Lond., 1895, I, 745.

Boy, 7½ years of age. Three days' illness with vomiting, constipation and abdominal pain ending in sudden death. No history of swallowing a pin.

Autopsy: Signs of recent general peritonitis especially about the cæcum. Appendix thickened, enlarged and perforated, and through the perforation projected a sharp point. On opening the appendix there was found a body much like a date stone composed of fæcal matter enclosing a pin with the point projecting.

(18) *Abbe*, New York (1895): (Personal communication.)

Child, aged 5. Operation. Appendix had been perforated by a pin which had ulcerated out and was in an abscess cavity, of which the sloughing appendix was the centre. The pin was considerably encrusted with salts.

There was no history of the pin having been swallowed.

(19) *Kammerer* (1895): Annals of Surgery, 1895, XXII, 274.

Boy, aged 7. Illness of a week. Tumor in right side of abdomen.

Operation: Laparotomy. Tumor in omentum. On separating some adhesions it was found that the distal half of the appendix was firmly embedded in the mass, and that an ordinary pin had passed through almost the entire length of the appendix, and had escaped through a perforation at the tip. There were very firm adhesions of appendix to the omentum showing that this could not have been the first attack.

(20) *McBurney*, New York (1896): (Personal communication to Dr. Kelly.)

Man, aged 29. Five days before admission was suddenly taken with cramps in abdomen, general at first, but soon confined to right iliac fossa. Patient up and about; stoops to right to relieve pain. Tenderness over right iliac region. No tumor. Dulness over Poupart's ligament. Temperature 98°, pulse 80.

Operation: Incision over tumor, which was made out under ether and an ounce and a half of pus evacuated. In the abscess cavity a large soft concretion was felt. On attempting to remove it, it was found to be very friable and crumbled, showing an ordinary pin as the nucleus. The appendix had sloughed off near its base. Recovery.

(21) *Syms* (1896): Annals of Surgery, 1896, XXIII, 604.

Woman, aged 21. Good health till seven years ago, when she first had symptoms of appendicitis with a large abscess which opened spontaneously and healed. Repeated similar abscesses for six years. Finally a large abscess which was opened and drained. Second operation for persisting sinus showed tip of appendix attached to fascia under which was a cavity to which sinus led. In the appendix was found a toilet pin, the head of which was the nucleus of a hard fæcal concretion.

(22) *Roberts* (1896): Am. Pract. and News, Louisville, 1896, XXI, 491.

Boy, aged 15 months. Strong baby, bottle-fed. Illness of one day; vomiting; diarrhœa with bloody stools. After the last action a tumor appeared on right side of scrotum, which proved to be a strangulated hernia.

Operation: The cæcum with the appendix formed the hernial contents. On lifting up the appendix a pin was seen protruding from its posterior wall. It had passed through the sac into the dartos of the scrotum, the head being in the end of the appendix. Appendix removed and cæcum returned. Recovery.

(23) *Deaver* (1896): A Treatise on Appendicitis, 1896, 36.

Woman, aged 33. Ten days before operation sudden sharp pain in right side with vomiting for two days. Pain persisting for a week with tenderness and rigidity. Mass in right iliac fossa size of orange, not painful. Temperature 103°.

Operation: Appendectomy. No pus. Omentum adherent. Appendix contained a black pin which had entered the canal point first.

(24) *Daland* (1897): Proc. Path. Soc., Phil., 1897, n. s. I, 55.

Adult male. For a number of months pain in appendicial region. On admission typical symptoms of acute appendicitis of ten days' duration. Tenderness and rigidity.

Operation: Appendectomy. Eight ounces of pus evacuated from abscess cavity. Recovery.

An ordinary pin was found occupying the lumen of the appendix and, although causing no perforation, there were evidences of chronic appendicitis, shown by considerable thickening of the walls, partial encapsulation and presence of adhesions. The pin had become almost black in color.

No history of swallowing a pin.

(25) *Lee* (1897): Lancet, London, 1897, II, 536.

Woman, with history of sudden seizure with violent pain in abdomen. Death soon after.

Autopsy: A pin was found in the appendix, the point of which had evidently fretted its way through the end of the appendix. The opening thus made communicated with an abscess in the peritoneal cavity.

(26) *Officer* (1898): Intercol. Med. Jour., of Austral., 1898, 229.

Boy, aged 6. Ill nine days; headache; drowsiness; vomiting and fever; abdominal pain. No tumor. Two days later abdominal distention and legs drawn up.

Operation: Laparotomy. Peritoneal cavity full of pus. Irrigation and drainage. Death in 36 hours.

Autopsy: General peritonitis. Appendix found with difficulty, and on attempting to cut it out an ordinary pin was encountered, which had ulcerated through the wall of the appendix and was lying partly across its lumen.

(27) *Rolleston* (1898): Trans. Path. Soc., London, 1898, XLIX.

Girl, aged 7. Stitch in right side for a year or so. Five weeks before death signs of right pleurisy. Fever. Later, operation for abscess of liver with evacuation of pus. Death from asthenia.

Autopsy: Appendix adherent to broad ligament and surrounded by recent fibrinous peritonitis, appendix cut open, and at the point where it was so firmly adherent a pin was found with its head inside the tube, lying transversely to the long axis of the appendix. The shaft and tip of the pin after passing through the wall of the appendix were surrounded by old adhesions. The whole of the pin was irregularly encrusted with calcareous matter. Abscesses of liver.

(28) *Keen* (1898): Trans. of Am. Surgical Assoc., 1898.

Man, aged 24. When seven years old he had a great deal of trouble in passing urine, and when examined by the family physician, a pin was found well down in the urethra. He does not remember that he inserted it, and believes he swallowed it.

In March, 1896, it was supposed that a recto-vesical fistula was established following a prostatic abscess, and food was frequently recognized in the urine.

In April, 1897, after two unsuccessful operations for the closure of this fistula, laparotomy was finally performed. A long appendix was detected, the tip of which was solidly incorporated into the bladder, thus acting as a third ureter and discharging fæces instead of urine into the bladder. The appendix was separated from the bladder and removed, and the patient recovered, but later died of intestinal obstruction due to a volvulus.

The two cases which follow are so much like those under consideration as to deserve being included with them. In these the cæcum instead of the appendix was perforated by a pin, and the clinical picture was that of appendicitis.

(29) *Boussi* (1878): Bull. Soc. clin. de Paris, 1878, II, 15.

Woman, aged 40. Three weeks before admission, during and after menstruation violent abdominal pain and fever. Admitted with tumor in right iliac fossa, semi-fluctuant and tender; chills and vomiting. Death in sixteen days.

Autopsy: Abscess beneath liver communicating with abscess in right iliac fossa. In the pus was a blackened pin, which had perforated the cæcum.

Patient did not remember swallowing a pin.

(30) *Southam* (1898): British Medical Journal, Apr. 30, 1898, 1130.

Man, aged 29. Admitted with symptoms of acute appendicitis. Four days previously sudden pain in right iliac fossa with vomiting. On admission there was fulness above Poupart's ligament, tender and dull on percussion; rigidity of abdominal walls. Attack subsiding at end of a week. On ninth and tenth days fæcal vomiting.

Operation: Incision over appendix. An ounce of thick foul pus evacuated in which was a fæcal concretion, ovoid in shape and three-quarters of an inch long. In the centre of this was a pin with the head and point protruding. Drainage. Recovery with fæcal fistula.

At a second operation, three months later, there was found a fistulous opening in anterior wall of cæcum three inches from origin of appendix. Appendix perfectly healthy. Fistula sutured. Recovery.

Five additional cases have come to our notice too late to be included in the substance of this paper, which thus make thirty-three instances in which we have found a record of the presence of a pin in the vermiform appendix.

One is especially interesting, in that it is the only case in which there is any history of swallowing a pin.

Another makes an eighth instance of the association of liver abscess with appendicitis.

(31) *Robert P. Harris*, of Philadelphia, in a personal communication to Dr. Kelly recalls a case seen by Dr. Wm. Pepper, Sr., in consultation with Drs. Hugh Hodge and Meigs, where Dr. Pepper differed from his consultants and made a diagnosis of peritonitis. The woman died of peritonitis, and at the autopsy "a pin was found sticking through the end of the appendix, the cause of the peritonitis."

(32) *Harley* (Diseases of the Liver. London, 1883, 846):

Boy, aged 19. Admitted with fever; a rapid pulse, and tenderness over liver. Death in nine days.

Autopsy: Large abscess of liver. At the very apex of the appendix was a thick brass pin an inch and a quarter long, the head somewhat green and eroded, pointing downwards, and projecting through the caudal extremity of the appendix. A drop or two of pus was found outside of the peritoneum.

(33) *Schooler*, Des Moines, Iowa (1895): (Personal communication to Dr. Kelly.)

Man, aged 48. While pitching hay felt uneasiness in right side of abdomen, which later increased to pain. On second day a large tumor in the region of the appendix was made out. An incision was made and a quantity of pus escaped. Wound packed. On the third day the packing was removed and an opening seen in the bottom of the wound. The finger introduced in this felt a sharp point, which proved to be a pin, surrounded by pus. It was withdrawn with forceps. The appendix was not seen.

(34) *Schooler*, Des Moines, Iowa (1898): (Personal communication to Dr. Kelly.)

Girl, aged 2. Had been complaining for several days. Under anæsthesia a decided swelling was made out in the region of the appendix.

Operation: Incision into abscess. Evacuation of three ounces of pus. A pin was found sticking through the wall of the appendix, the head remaining inside. Appendix removed and wound packed. Recovery. The child had swallowed a pin several months before.

(35) *Harlow Brooks*, New York (1899): (Personal communication.)

Woman, aged 54. Illness of a week; headache and general pains; incontinence of urine and fæces. Diagnosis of "epidemic influenza, complicated by broncho-pneumonia." Death in ten days.

Autopsy: Diagnosis of broncho-pneumonia verified. The appendix was 8 cm. long; its tip dropped down into the pelvic cavity and was adherent to the right ovary which had become almost completely transformed into a cyst. Just at the centre of the appendix, where there were dense adhesions to the psoas muscle, there was a small cavity enclosed by the surrounding cicatricial tissue and containing pus and fæces. This abscess communicated with the lumen of the appendix. Lying in the proximal portion of the appendix, with its head at about the location of the abscess, was an ordinary pin encrusted with lime salts and fæcal matter. The pin lay with its head down, the shank extending up in the lumen of the appendix.

ORIGIN, DEVELOPMENT AND DEGENERATION OF THE BLOOD-VESSELS OF THE OVARY.*

(*From the Anatomical and Gynæcological Laboratories of the Johns Hopkins University.*)

PRELIMINARY STATEMENT.

AN ANATOMICAL AND PHYSIOLOGICAL STUDY OF THE VASCULAR SYSTEM OF THE OVARY AND ITS INFLUENCE UPON THE SUCCESSIVE STAGES AND ACCOMPANYING PHENOMENA OCCURRING IN THE EVOLUTION OF THE GRAAFIAN FOLLICLE. ALSO A CONSIDERATION OF THE RELATIONSHIP OF THE CORPUS LUTEUM TO THE CONSERVATION AND TO THE FINAL CESSATION OF OVULATION.

By J. G. Clark, M. D., *Late Resident Gynecologist in the Johns Hopkins Hospital, Associate in Gynæcology in the Johns Hopkins University.*

In February, 1896, at the suggestion of Prof. Mall, I began the study of the ovarian circulation, with a view of determining the normal distribution of the arteries and veins of the ovary and their relationship to each other. At first sight the solution of this question did not appear to present greater difficulties than those encountered in the ordinary course of any research. A study of the sections of a few injected adult ovaries, however, at once demonstrated the futility of attempting to draw any conclusion from this source, for the close crowding

* Presented before the Johns Hopkins Medical Society, December 19, 1898.

together of the parallel vessels of the medullary portion, and the markedly irregular course of those in the cortex or follicle-bearing zone, rendered impossible any accurate observations concerning the relative number and distribution of the veins and arteries, and the exact course followed by each system.

With a view, therefore, of securing ovaries possessing a simpler scheme, a study was made of the lower animals, such as the dog, rabbit, guinea-pig, sheep and pig, but with unsatisfactory results, and only after the injection of the generative organs of a monkey was a suggestive clue secured. Beyond this point, however, it was difficult to proceed, and only after the injection of a very large series of ovaries from individuals, ranging in age from a six-months fœtus to a woman many years beyond the menopause, were final conclusions reached.

In the search for this normal scheme through an extensive number of serial sections, various questions directly dependent upon the circulation have presented themselves for solution, which have widened the scope of this work until it has developed into a composite anatomical and physiological research.

Thus the various vital phenomena have been considered which transpire within the follicle from its embryological origin and progressive growth to the time of its disappearance, either through an obliterative process or through its rupture, organization as a corpus luteum and final retrogression as a corpus fibrosum. In this connection theories have been suggested as to the cause of ovulation, the synchronism of ovulation and menstruation, the mechanism of the rupture of the mature follicle and the final cessation of ovulation, which have been based upon observations made in the study of a very large number of sections.

Soon after beginning this work I was struck not only with the difficulty of arriving at a definite knowledge of the scheme, but also of determining the age at which this scheme may be taken as a standard for comparison.

This is certainly not possible after active ovulation is established for the constant changes in the vascular system induced through the maturation, rupture and organization of the follicle, introduce an element of variability into the circulation of this organ which, so far as I know, occurs in no other.

Failing to reach any satisfactory starting point in the adult, the ovary of a girl approaching puberty was next studied, but with little less success, for it was found that almost as constant variations occur in the follicular circulation before as after the inauguration of ovulation. In the hope of finally reaching a period in the life of the female individual, at which a definite standard for comparison might be found, numerous specimens from children of various ages were injected and closely studied. Finally the ovary of a six-months fœtus was obtained, which furnished a definite clew as to the arrangement of the vessels, but as the follicular apparatus was still in process of development a new-born child in which the tunica albuginea was well formed was selected as the standard. Even here the solution of the question was not easy, for in order to trace the ramifications of the vessels from the point of their entrance into the ovary to their ultimate termini the study of the serial sections of many ovaries was necessary.

To briefly summarize the chief points in this investigation I have considered them under a skeleton outline, the main headings of which will conform in general to the arrangement in my forthcoming paper.

In this preliminary statement it is impossible to more than hint at the points which will, in the final publication, be developed through schematic demonstrations and many drawings from injected specimens, and for the same reason references to the numerous researches which have been made upon many of the subjects considered in this report must be omitted.

EMBRYOLOGICAL CONSIDERATIONS.

The primitive circulation of the Wolffian body will be dwelt upon, and an explanation of the origin of the spermatic vessels as an independent system from that of the former will be offered. As is well known among embryologists the Wolffian and Müllerian ducts are well formed and the germinal eminence is of considerable size before visible signs of the differentiation of sex become manifest. Up to this point the embryo is said to be of the hermaphroditic or indifferent type.

In retracing the steps of development from the well-formed embryo back to this period some very interesting points concerning the differentiation of sex have been secured. The radical differences existing between the vascular system of the testicle and ovary have furnished a valuable sign for determining the gender of very young embryos, before the external differential marks are established.

The fact to which attention will be directed especially is that the testicular circulation is peripheral, the main artery of which courses over the dorsal aspect of the organ, giving off in its course rib-like branches which in turn send penetrating branches into the gland. Between the arteries are situated the collecting veins which unite at the base of the testicle to form the spermatic plexus.

In the ovary this scheme is exactly reversed, the arteries with their accompanying veins entering the center of the organ where they branch tree-like and terminate as a fine capillary anastomosis in the tunica albuginea.

Upon the peculiarities of each circulation the differential signs of sex are based—a visible dorsal vessel always indicating a male; an alabastic-like non-vascular white cortex a female embryo.

In microscopic sections the presence of large peripheral vessels also indicates the male, whereas large central vessels indicate the female sex.

The significance of the vascular arrangements in the testicle and ovary will also be discussed from the physiological standpoint, and to the radical differences existing between them will be ascribed the persistence of the testicular function in the male to old age, and the comparatively early abrogation of ovulation in the female. In the testicle the production of sperma is a more or less fixed and constant function like that of the pancreas, the parotid and other secreting glands, consequently the circulation is not subject to variations and is only interrupted through disease or through senile changes, whereas in the ovary there is a constant variation in the circulation incident to the obliteration or disappearance of follicles and the compensatory production of connective tissue which sooner or

later begins to limit the peripheral circulation, and this in turn leads though secondary influences to a final cessation of ovulation.

Incidentally, I may remark that these wide differences in the circulation lead me to the conclusion that the origins of the ovary and testicle are not as generally believed the same, but are totally different, and that the expressions "asexual period," "hermaphroditic stage of the embryo," etc., merely serve to mask our inability to select the differential features of the sexes back of this point.

In view of the fact that the common progenitor of the ovary and testicle is the Wolffian body and that the atrophy or degeneration of the latter is coincident with the active growth of the former, an endeavor has been made to discover the explanation of this apparent paradox. According to my observations upon this point, it lies in the fact that the vascular system of the sexual glands originates entirely independently of that of the Wolffian body, consequently the synchronous development and degeneration of the two sets of organs is possible.

Having traced the development of the circulation in the ovary and testicle from the so-called asexual period to the point where they have formed systems diametrically opposite in their distribution and ultimate arrangement, the further consideration of the testicle will be dropped and the study of the ovary along the line of its development and progression to its ultimate history will be pursued.

Development of the Graafian Follicle.

My study leads me to reject the Valentine–Pflüger theory concerning the origin of the follicle and to accept, with some reservation, the general scheme of development as suggested by Waldeyer. So far as the genesis of the "egg nests" and their ultimate subdivision into follicles are concerned, I am in accord with the latter investigator, but as to the origin of the so-called follicle epithelium or membrana granulosa, I feel that the evidence in my hands is sufficient to put me at variance with Waldeyer's conception and to incline me towards that of Foulis, who believes that the germinal epithelium only forms ova and that the lining membrane of the follicle is derived from the connective tissue stroma.

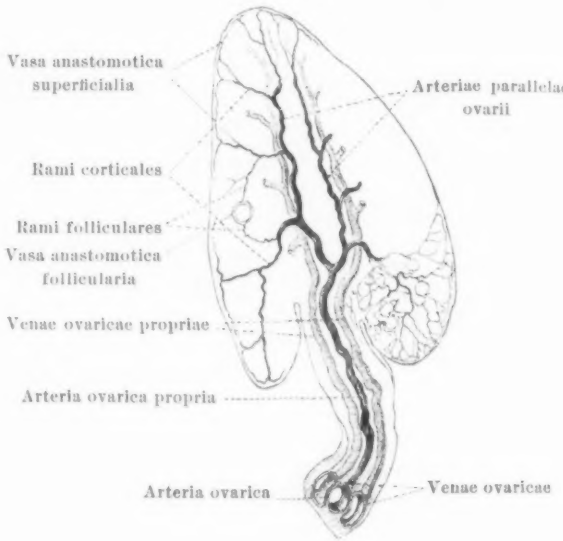
The Ovarian Circulation of the New-Born Child.

With the completion of the fibrous covering of the ovary (tunica albuginea) shortly after birth, the vascular system becomes fully developed, and this period, therefore, may be said to represent the typical scheme, for up to this point there has been no derangement of its central or peripheral branches, which will occur later through the progressive development and degeneration of follicles.

The secondary branches of the circulatory tree occupy a comparatively small medullary area, its tertiary branches being given directly off into the follicle-bearing zone. The follicles are, as as rule, still in their primitive state, only a few of the many thousands as yet showing progressive development.

Even at this early period, however, isolated follicles undergoing progressive and retrogressive changes may be noted. These changes, as I shall hope to show, are closely analogous to if not identical with those occurring in the ovaries of older children, and in women after ovulation is inaugurated.

The arrangement of the circulation as established at this early age is shown in the following schematic way:



As will be seen from this sketch each follicle is provided with a vascular wreath, which is formed by the terminal twigs of the main cortical branches.

The development of this wreath and its final obliteration, along with the disappearance of the corpus luteum, does not affect the general scheme, for it merely represents one small terminal system, the destruction of which, so far as its effect upon the general system is concerned, is like the lopping off of an ultimate twig of the branch of a large tree.

For this reason the changes in the ovarian circulation incident to the progressive development and degeneration of the follicles, even in early womanhood, are local and not general. It is only in the later periods of the ovulating life of the female that the latter effect is noted. Beyond the follicular zone the terminal vessels break up into capillaries which form a fine parallel running anastomosis in the tunica albuginea, which hitherto has not been described.

The extensive anastomosis throughout the ovary renders easy the shifting of the circulation from one set of vessels to another, consequently the destruction of the function of the ovary is almost an impossibility before its final cessation through natural causes.

In the same way the persistence of the function in even tiny bits of the ovary, which are occasionally left after an ovariotomy, may be explained.

In order to conform to the new method of classification, recently decided upon by anatomists, a system of nomenclature has been adopted which is based upon the regional distribution of the vessels.

CLASSIFICATION OF VESSELS:

ENGLISH.	LATIN.
Ovarian artery.	Arteria ovarica.
" veins.	Venæ ovaricæ or Vv. ovaricæ.
Extra ovarian or hilus branch of artery.	Arteria ovarica propria or Aa. ovaricæ propriæ (Ramus I, II, III, IV, V).
Extra ov., or hilus branches of veins.	Venæ ovaricæ propriæ.
Medullary branches.	Rami medullares or arteriæ parallelæ ovarii.
Cortical branches.	Rami corticales.
Peripheral anastomosis.	Vasa capillaria anastomotica superficialia.
Follicular branches.	Rami folliculares.
" anastomosis.	Vasa anastomotica follicularia.
Utero-ovarian anastomosis.	Arteria anastomotica uterina.

In order to follow the progressive changes in the ovary from birth to the climacteric, specimens from my collection representing the following ages have been selected: child of 2 years, girls of 9 and 12 years, and of 14 years, just after the establishment of ovulation, young woman of 24 years, middle-aged woman of 35 years, woman approaching the menopause at 42 years, and finally an old woman of 66 years, long after the menopause.

In these specimens an endeavor has been made to follow not only the changes incident to the circulatory system, but also the other progressive histological transformations.

The comparison of this ascending series has suggested certain hypotheses concerning the physiology of the ovary, which I trust have been strongly sustained, if not confirmed, by the specimens in hand.

THE OVARY OF A CHILD OF TWO YEARS.

In the six-months fœtus the main branches of the ovarian artery correspond in the general form of their distribution to the fasciculi of a widely spread folding-fan, the divisions between the arteries being filled with primitive follicles.

As the ovary grows in age the vessels with the connective tissue septæ, which form these divisions, change from a gently curved to a perpendicular course, the branches occupying the medullary portion being crowded into parallel lines (arteriæ parallelæ ovarii).

In the two year old child, through the development and retrogression of numerous follicles from birth up to this time, the medullary area comprises a much larger portion of the ovary than that noted in the new-born.

As there is no increase in the number of follicles after birth the obliteration of each primitive or partially developed one naturally decreases the total original number, which results in an increase in the medullary portion of the ovary at the expense of the follicle-bearing or cortical zone.

The law of development in the follicle is from within outward, that is the primitive follicles lying nearest the central circulatory tree are the first to undergo development.

In the young child the developing follicles instead of moving towards the periphery, as occurs in the girl approaching puberty or in the adult, tend to maintain their primitive position, their enlargement being simply centripetal without any attempt at mobilization.

Having reached a certain stage in their development, a retrogressive change following the degeneration of the ovum is inaugurated, and the original site, occupied by the follicle, is replaced by a very minute addition of connective tissue to the stroma of the organ, which naturally builds up through successive accumulations the central area.

Follicles in various stages of development and retrogression are noted in all ages after birth, and according to my observations the same principle involved in the obliteration of the unruptured follicles before puberty governs the organization of the corpus luteum after ovulation is inaugurated.

Briefly stated the changes consist in an increase in the vascular wreath around the primitive follicle and a coincident or dependent hyperplasia of the membrana propria and an accumulation of liquor folliculi.

What determines the cessation of these progressive changes and the beginning of the retrogressive or obliterative process remains unexplained. The fact remains, however, that with the degeneration of the ovum the liquor folliculi is absorbed and the cavity is filled in with large embryonic connective tissue cells arising from the theca interna.

Through the gradual diminution in the blood supplied by the follicular wreath the excess of connective tissue undergoes hyaline changes and absorption until finally only a mere trace of the new-growth remains.

In this way the size of the ovary is maintained within reasonable bounds. Were each mature or large follicle to be replaced by permanent connective tissue, the ovary would very early in life assume the proportions of a new-growth, which sooner or later would constitute fibromata of no mean dimensions.

PROGRESSIVE CHANGES IN THE OVARY.

In the progressive growth of the ovary the obliterative changes just referred to continue until the follicle-bearing area, reduced by many thousands in its numbers of primitive follicles, becomes a narrow zone compared with its width in the new-born child.

The crowding together in more or less parallel lines of the secondary and tertiary branches of the ovarian vessels is, to return to our analogy, simulated by the partial closure of the fasciculi of the fan. The increase in the internal resistance through the building up of a denser medullary centre and the closer crowding together of the parallel vessels sooner or later breaks the equilibrium of forces and consequently the follicles no longer maintain their primitive position while enlarging but undergo mobilization towards the tunica albuginea, that being the direction of least resistance.

The actual rupture of the follicle, according to my opinion, is due to the influx of blood during the menstrual cycle into the medullary blood-vessels, which has a double action, first to push the mature follicle rapidly towards the surface, and

second, through the increased pressure, to close the parallel running anastomosis in the tunica albuginea, and thus permit a physiological necrosis and rupture of the follicle.

Concerning the question of ovulation and menstruation I shall endeavor to offer further evidence to prove that the rule of synchronism is the normal, and that deviations from this rule are probably due to modifications in the life habit incident to changes in environment and to departures from primitive methods of living and from primitive laws governing sexual congress.

A brief paragraph will be devoted to the processes through which the mature but unruptured follicles undergo obliteration. I shall assume that this is not a pathological condition, but is merely Nature's method of getting rid of a functionless cavity. The organization of the vascular system of the corpus luteum, followed by its retrogressive changes and final disappearance, will be considered, and I shall take the position that little or nothing of the follicular vascular system remains when the resorption of the corpora fibrosa is complete.

As a conclusion to this study the cessation of ovulation will be ascribed to the gradual impairment of the vascular systems, through first, densification of the ovarian stroma and second, through the retroactive effect of imperfectly removed corpora lutea, which as an end result diminishes the blood-supply to the cortical area to such an extent that the growth of the primitive follicles is retarded and finally completely inhibited. These final retrogressive changes lead up to and constitute the menopause or climaterium.

OVARIAN CYSTS IN THE NEGRESS.

By Thomas R. Brown, M. D.

Comparatively little has been written concerning ovarian cysts in the negress, probably partly because that in most hospitals where extensive gynecological operations are performed the proportion of negro patients is very small, and partly because of the comparative rarity of this condition in negro women.

In fact, one frequently hears surgeons say: "The tumor before us presents all the features of an ovarian cyst, but inasmuch as the patient is a negress it is certainly not so, but a tumor of different origin (cystic myoma, etc.), as multilocular cysts are unknown in the negress."

That ovarian cysts are much rarer in negresses than in white women no one will deny, but as to the exact numerical relationship between the two few if any figures of importance are obtainable, and the object of this note is to give definitely and numerically this proportion as obtained by an analysis of ovarian cysts of various kinds operated upon at the Johns Hopkins Hospital.

In considering ovarian cysts the usual divisions have been made into (*a*) simple retention cysts, including Graafian follicle and corpus luteum cysts; (*b*) unilocular and multilocular ovarian cystomata, the two being considered together, as many regard the unilocular cysts as originally multilocular; (*c*) papillary cysts and (*d*) dermoid cysts of the ovary; also for sake of completeness parovarian cysts and intraligamentary cysts have been considered.

I shall discuss the frequency of ovarian cysts in the negress first (I) from a clinical and macroscopical standpoint, and second (II) from a microscopical and pathological standpoint, which is much more important.

I.

An analysis is here given of the various kinds of ovarian cysts occurring in the white and the colored for a period of six years, from January 31st, 1892, until January 31st, 1898, the variety of cyst being determined by clinical observation and macroscopic appearance.

Total No. of cases of all kinds treated in the gynecological service.		Varieties of cysts.											
		Dermoid cysts.		Simple cysts (Graafian follicle and corpus luteum cysts).		Unilocular and multilocular cysts.		Papillary cysts.		Parovarian cysts.		Intraligamentary cysts.	
Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.
3996	589	17	7	88	3	53	2	14	0	4	0	3	0

It will thus be seen that out of 191 cysts, only 12 were in the negress, a proportion of 1 : 15, while the proportion of colored to white gynecological patients treated during the same period was 1 : 6.75 (589 : 3996), *i. e.* ovarian cysts were relatively 2.2 times as frequent in white as compared with colored women.

When we analyze the proportion in the different varieties of cysts, we arrive at some striking results.

In the case of the dermoid cysts, cysts due to the inclusion of some of the embryonic ectoderm in the ovarian tissue, we find that 7 of the 24 cases reported were in the negress, *i. e.* 1 : 2.5 (7 : 17), which would seem to indicate that the dermoid cysts are relatively more than twice as common in the negress as in the white woman (the proportion of white to colored gynecological patients being 1 : 6.75).

As regards simple retention cysts, the proportion of 3 to 88 (*i. e.* 1 : 29.3) is probably not a fair estimate, due to the fact that what to call a Graafian follicle cyst and what to call a dilated Graafian follicle depends largely upon the individual operator.

When we consider unilocular and multilocular cysts, however, we are struck at once by their remarkable infrequency in the negress, of the 55 cases mentioned only 2 being in that race, *i. e.* a proportion of 1 : 26.5.

This is of especial importance, because this form of cyst of the ovary grows to the largest size, and it is this variety of cyst which many surgeons declare never occurs in the negress.

No cases were reported of papillary cysts of the ovary, parovarian or intraligamentary cysts in the negress.

Thus it will be seen that with the exception of dermoid cysts, ovarian cysts are really much less common in the colored race, the results, however, being more or less indefinite, due to the fact that the diagnosis was made clinically and macroscopically and not microscopically.

II.

An analysis of ovarian cysts from the microscopical standpoint was made from all cases operated upon in the Hospital from the latter part of 1893 until October, 1898.

During that time there had been microscopically described and diagnosed in the Gynecological-Pathological Laboratory 244 ovarian and parovarian cysts, divided as follows: Dermoid cysts 32, Graafian follicle cysts 68, corpus luteum cysts 16, unilocular and multilocular cysts 94, papillary cysts 10, and parovarian cysts 24.

(*a*) Dermoid cysts. Of the 32 dermoid cysts, 6 were in the colored, *i. e.* the proportion is 1 : 4.3, showing, as in the clinical study above, that these cysts are relatively more common in the negro race.

CASES OF DERMOID CYST OF THE OVARY IN THE COLORED.

CASES.	PATHOLOGICAL REPORT.	REMARKS.
(1) S.	Dermoid cyst of right ovary, 7 cm. in diameter	
(2) J.	Dermoid cyst of ovary, 16 cm. in diameter	
(3) I.	Dermoid cyst of ovary, 7 cm. in diameter	Myomatous uterus.
(4) S.	Dermoid cyst of ovary, 8 cm. in diameter	
(5) V.	Dermoid cyst of ovary, 4.5x3.5x3 cm	2 intraligamentary myomata.
(6) C.	Dermoid cyst of right ovary, 2.5 cm. in diameter.	Myomata uteri.

(*b*) Retention cysts. Of the 84 simple retention cysts (68 Graafian follicle cysts, 16 corpus luteum cysts), 7 were in the colored, a proportion of 1 : 11, showing that these cysts are relatively less common in the negress than in the white woman (as stated before, the proportion of colored to white gynecological patients being 1 : 6.75).

CASES OF SIMPLE RETENTION CYSTS IN THE COLORED.

CASES.	PATHOLOGICAL REPORT.	REMARKS.
(1) S.	Right unilocular ovarian cyst, probably dilated Graafian follicle, intraligamentary, 9 cm. in diameter.	Double pyosalpinx.
(2) C.	Right corpus luteum cyst, 5 cm. in diameter.	Epithelioma of cervix.
(3) W.	Cyst of ovary from corpus luteum or Graafian follicle, 6x4x4.5 cm.	Double perisalpingitis and perioöphoritis.
(4) W.	Corpus luteum cyst, unilocular, 5 cm. in diameter.	
(5) B.	Cyst of left ovary, 5 cm. in diameter (probably of Graafian follicle).	Myomata uteri.
(6) B.	Graafian follicle cyst of right ovary, 4 cm. in diameter.	Myomata uteri.
(7) T.	Right Graafian follicle cyst, 4x3 cm.	

(*c*) Unilocular and multilocular cysts. Of the 94 unilocular and multilocular ovarian cysts, but 6 were in the colored, the proportion thus being but 1 : 14.7, showing that this form of cyst is relatively more than twice as common amongst white women.

It shows, however, that they are by no means so uncommon in the negress as popularly supposed.

CASES OF UNILOCULAR AND MULTILOCULAR OVARIAN CYSTS IN THE COLORED.

(1) G.—Color, black.

Pathological Report.—Multilocular ovarian cyst. Myoma uteri.

(2) H.—Color, black.

Examination.—Abdomen, especially right side, is distended by a firm elastic tumor mass reaching 9 cm. above the umbilicus, its longest axis being 23 cm. In left inguinal region is felt a hard, irregular mass, the size of a small hen egg.

Operation.—Cystectomy. Hystero-myo-salpingo-oöphorectomy.

The cyst was thin-walled, filled with bloody fluid; it was developed from the outer pole of the right ovary and was entirely retroperitoneal. The uterus was myomatous, and there were many adhesions, especially about the cyst.

Pathological Report.—Multilocular cyst of right ovary 16 cm. in diameter, springing from the upper pole; the cyst wall is 1 mm. thick, the fluid is dark reddish-chocolate colored. Myomata uteri.

(3) I.—Color, black.

Examination.—Abdomen is much distended in its lower half, and a large mass of irregular outline can be palpated; to the right it feels elastic; to the left hard. The upper border of the mass reaches in the right parasternal line to within 11 cm. of the costal margin. Transversely it measures 29 cm.

Operation.—Cystectomy. Hystero-myo-salpingo-oöphorectomy.

On the right side a multilocular ovarian cyst posterior to the uterus, filling the cul-de-sac and rising above the pelvic brim, with its walls intimately adherent to the intestines. Myomatous uterus, size of fœtal head.

Pathological Report.—Ovarian cyst (either multi- or unilocular, probably the latter); fluid is clear, limpid and yellowish. Myomata uteri.

(4) C.—Color, black.

Examination.—Abdomen is irregularly distended. On palpation a mass, divisible into two separate masses, can be made out, one occupying the lower portion of the abdomen, with irregular outline and nodular surface, the other reaching as high as the costal margin on the left, measuring 9x12½ cm. with smooth surface and elastic feel.

Operation.—Hystero-myomectomy. Cystectomy.

The cyst was punctured and the fluid withdrawn before the enucleation was started.

Pathological Report.—Left unilocular ovarian cyst, 7 cm. in diameter.

(5) F.—Color, black.

Examination.—The body of the uterus is apparently of normal size and is pressed backwards by a large abdominal tumor, which is firm, elastic, tense, of smooth surface and gives a distinct wave of fluctuation. Corona of resonance is well marked.

Operation.—Cystectomy (left). Right salpingo-oöphorectomy.

The cyst-wall was punctured, the fluid obtained therefrom being of a muddy brown color. The cyst sprang from the left ovary and was adherent to the omentum. The right tube and broad ligament were plastered over the surface of the cyst. Right salpingitis. The uterus contained a few myomatous nodules.

Pathological Report.—Large multilocular cyst of left ovary, 19x18 cm., containing 1800 c. cm. of dark brown fluid containing much albumen.

(6) H.—Color, black.

Pathological Report.—Right multilocular ovarian cyst, 6 cm. in diameter, dense adhesions, cyst of left ovary 5 cm. in diameter, containing blood and débris.

Thus it will be seen that, although these cysts are less common in the negro race, nevertheless they do sometimes occur, and reach as large a size in some cases as the corresponding cysts in the white race, and thus the possibility of their being present should always be seriously considered when the physical examination points in that direction.

(*d*) Papillary cysts. No case of this kind was found in the negress in the cases analyzed.

(*e*) Parovarian cysts. Of the 24 parovarian cysts, only 1 was in the negress, showing the extreme rarity of this variety of cyst in this race.

(1) A.—*Pathological Report.* Right parovarian cyst. Myoma uteri. Left salpingitis.

Thus, of the 244 cases of ovarian and parovarian cysts, but 20 were in the colored race, *i. e.* the proportion is 1 : 11.2, showing that the relative frequency of these cysts is 1.66 times as great in the white as in the colored race.

If we exclude the parovarian cysts, of the remaining 220 true ovarian cysts 19 were in the negress, a proportion of 1 : 10.6, *i. e.* the relative frequency is 1.57 times as great in the white as in the colored race.

If we exclude the dermoid cysts, cysts which owe their origin to some defect in embryonic development, of the remaining 188 ovarian cysts (corpus luteum, Graafian follicle, multilocular, unilocular and papillary cysts), but 13 were in the colored, *i. e.* a proportion of 1 : 13.4, showing that these cysts are *relatively* exactly twice as frequent in white women as in colored.

Perhaps the thing that strikes one most in studying these cases is the extreme frequency with which the ovarian cysts in the colored are associated with other pathological conditions, especially with a myomatous condition of the uterus.

In 10 of the 20 cases reported, uterine myomata were also found. These were distributed as follows: In 3 of the 6 cases of dermoid cysts; 2 of the 7 cases of Graafian follicle and corpus luteum cysts; 4 of the 6 cases of unilocular and multilocular cysts; and in the 1 case of parovarian cyst reported.

In 3 of the 20 cases salpingitis, perisalpingitis or pyosalpinx was reported, *i. e.* evidences of inflammatory trouble, distributed as follows: In 2 of the 7 cases of corpus luteum and Graafian follicle cysts, and in the 1 case of parovarian cyst.

Thus, to summarize our results, while the simple retention cysts and the unilocular and multilocular ovarian cysts are seen relatively much less frequently in the negress than in the white woman, they are present relatively much more frequently than is universally supposed; while from both a clinical and pathological study the dermoid ovarian cyst seems to be relatively more frequent in the negro race.

ON A HITHERTO UNDESCRIBED PEPTONISING DIPLOCOCCUS CAUSING ACUTE ULCERATIVE ENDOCARDITIS.

(PRELIMINARY REPORT.)

By W. G. MacCallum, M. D., and T. W. Hastings, M. D.

(*From the Pathological Laboratory of the Johns Hopkins University and Hospital.*)

A. S., aged 37, was admitted to the service of Dr. Osler, September 14, 1898. Occupation and family history unimportant; personal history negative, excepting for an account of an indefinite febrile attack of three weeks' duration, in 1889, which was said to have been rheumatic fever.

Since July 4th, after contracting a severe cold, he had a fever which had been persistent until early in August, when it subsided but reappeared about the middle of the same month, and for this supposed relapse of typhoid fever the patient was sent to the hospital.

The signs of aortic valvular disease were noted on admission and the diagnosis of septicæmia and probable malignant endocarditis affecting the aortic valves was made after obtaining positive blood cultures on September 24th.

The growth from the blood cultures was thought to be a short-chained streptococcus often occurring in pairs, but subsequently, on study of that obtained upon different media, it proved to be a definite diplococcus. On October 1st, three days before death, blood cultures were taken a second time from the basilic vein with the same positive result.

The autopsy revealed an acute vegetative and ulcerative aortic and mitral endocarditis. The aortic valves were bound together by exuberant branching vegetations which had undergone ulceration; several of the mitral chordæ tendineæ were ruptured and the broken ends covered with vegetations. In the spleen and kidney there were septic infarctions in various stages of softening, the fresher ones being firm and white, the oldest forming large thin-walled cavities with almost diffluent contents. One such embolic abscess was found in the ileum. There was also a bronchopneumonia of the left lung.

Sections of the aortic valves showed the fibrinous vegetations to be loaded with masses of diplococci, and in those passing through the infarcts in the kidney plugs of similar cocci were found in the vessels at the edges of the infarcted area. From the heart's blood and the aortic vegetations, as well as the infarcts in the spleen and kidney and from the lung, pure cultures were obtained of the diplococcus which presented, in brief, the following morphological and biological characters:

Morphology.—A small somewhat elongated diplococcus occurring sometimes in chains of four, but generally in pairs,

which stained easily by methods of Gram and Weigert. No demonstrable capsule.

Agar Growths showed minute semi-translucent pin-point deep colonies and corresponding minute discrete translucent round superficial colonies. On slant agar the smear gave rise to a thin translucent growth made up of conglomerated colonies, the edge of which is slightly raised and crenated.

Glucose and ascitic fluid agar afforded a more profuse and rather less translucent growth, while on glycerine agar the growth was comparatively scanty. There was no gas formation in glucose agar.

Potato.—The growth was slow to appear; after two or three days it showed as a dry whitish or tawny layer.

Bouillon was rendered very slightly opalescent after forty-eight hours.

Litmus-milk was decolorized within four hours. Later (within forty-eight hours) the milk was coagulated and acidified. After this there was a rapid peptonization of the coagulum, the medium becoming transformed first into a turbid purplish fluid, or a turbid yellow fluid, overlaid by a layer of red, and later into a quite clear blood-red fluid. This reaction is very characteristic and absolutely constant.

Blood Serum.—The growth appeared in minute discrete dew-like colonies. Within forty-eight hours there appeared a depression on the surface of the medium corresponding with the line of smear. Liquefaction of the medium occurred in course of time.

Gelatin was rather slowly but completely liquefied. Stab cultures took on the appearance of a wide funnel after about four days.

The sediment of organisms like the colonies on gelatin plates had a pale sulphur-yellow color.

The organism is quite hardy and may be recultivated from tubes several weeks old.

Anaërobiosis.—It is a facultative anaërobe, cultures in Buchner jars growing with about the same profusion and rapidity as the aërobic controls. In an atmosphere of hydrogen the growth is rather less abundant.

Thermal Death Point.—The diplococcus is killed in five minutes by a temperature ranging between 60° and 65° C.

Pathogenicity.—Laboratory animals succumb to inoculation. White mice do not survive the intraperitoneal injection of suspension of the cultures. Death may take place as early as eight hours or be delayed for three or four days. The microorganism can be recovered from the blood and organs generally.

The subcutaneous inoculations of mice also produce fatal effects after a longer period—two to four days. In the latter positive experiments no lesion was found at the point of inoculation and the organism was not recovered from any source.

Rabbits appeared less susceptible. Of several experiments one rabbit which received 3 cc. of a suspension of the organism intravenously succumbed in 16 days. At the autopsy there was found an abscess at the site of inoculation, and from this as well as from the distended urinary bladder the organism was recovered.

One dog has thus far been inoculated after injury of the aortic valves by the passage of a probe into the heart through the carotid (Rosenbach's operation), the culture being thrown into a vein. After five days the dog was killed and the autopsy revealed a fresh vegetative endocarditis, the vegetations springing from the edges of the perforation in the valve and from the point on the aortic wall where the intima was scraped off by the probe. There was also an extension of the vegetations onto the mitral valve; and at the point where the probe passed into the intraventricular septum an acute suppurative myocarditis had formed. The organism was recovered in pure culture from the aortic vegetations and from the heart's blood and organs generally.

Experiments with the ferments and toxines are in progress and will be reported later.

This diplococcus which has been proven to be pathogenic for man and some of the lower animals seems not to have been met with before—at least, there is no record of such an organism to be found in the bacteriological literature available to us. The chief peculiarities which distinguish it from the pyogenic cocci already described are:

(1) The mode of growth which resembles that of the micrococcus lanceolatus, the diplococcus intracellularis meningitidis and the streptococcus rather than that of the pyogenic staphylococci.

(2) The action on gelatin which resembles that of the staphylococci.

(3) Its activity in peptonizing milk and coagulated blood serum in which it differs from all the above-named pyogenic cocci.

In virtue of this last property and for the purpose of distinguishing it for the present, we propose the name *Micrococcus zymogenes.*

ALFREDO ANTUNES KANTHACK.

Died at Cambridge, England, on the twenty-first of December, 1898, Alfredo Antunes Kanthack, M. A., M. D., F. R. C. P. (London), Fellow of King's College and Professor of Pathology in the University of Cambridge.

This announcement is a cruel blow to those who have had the good fortune to know and work with this brilliant man. Born in Brazil in 1863, the son of the former British consul at Para, Kanthack received much of his early education in Germany. Studying in England at the University College in Liverpool and at London University, he obtained his B. A. in 1884, his intermediate M. B. in 1885, and B. Sc. in 1886. Pursuing his studies at St. Bartholomew's Hospital, he received in 1887 the double qualification of M. R. C. S. and L. R. C. P. In 1888 he obtained the F. R. C. S. as well as the M. B. and B. S. (London), with honors, receiving also the gold medal for obstetrics. The year 1889 Kanthack spent in work under Virchow in the pathological laboratory at Berlin, but he was compelled in 1890 to leave, in the midst of some important investigations, to serve as obstetrical assistant in St. Bartholomew's Hospital under Dr. Matthews Duncan.

In the summer of 1890 he went to India as one of the commissioners appointed by the Royal College of Physicians, the

Royal College of Surgeons and the Executive Committee of the National Leprosy Fund to inquire into various points with regard to leprosy in India. A large share of the voluminous report of the commission was his work. Returning from India he became the John Lucas Walker student at Cambridge, but in 1892 he went to Liverpool with the intention of practising medicine. Here he held the post of medical tutor and demonstrator of bacteriology at the Royal Infirmary. Later, however, he went to London as director of the pathological laboratory, lecturer on pathology and bacteriology, and curator of the pathological museum at St. Bartholomew's Hospital. In 1896, during the illness of Professor Roy, he was appointed his deputy, and finally in the fall of 1897 he became professor of pathology at the University of Cambridge. In the same year he became an F. R. C. P., and was given the honorary degree of M. A. at Cambridge.

In his school days Kanthack had planned to devote his life to classical studies, and it was a disappointment to him at first to be compelled to turn to what he feared must be a more practical career; but from the beginning his energy and ability brought him enthusiasm and success. In the laboratory at Berlin he earned the admiration of all who knew him, and his early work in Virchow's Archiv on the pathology of the larynx* gained for him the recognition of many others. By no one was he more appreciated than by his great "Master" as he reverently called him, whose attitude toward his pupil was one of genuine affection.

The feeling of his contemporaries cannot be better shown than by quoting in full the cordial letter of Prof. Langerhans, written at the time of his application for the professorship of pathology at Cambridge:

"Herr Dr. med. Alf. A. Kanthack, zur Zeit in Cambridge, hatte vom Sommer 1889 bis August 1890 im Berliner pathologischen Institut einen Arbeitsplatz in demjenigen Arbeitssaal inne, welcher für vorgeschrittene, selbstständige wissenschaftliche Arbeiter bestimmt ist und für welchen ich damals als zweiter Assistent von Rudolf Virchow meinem Chef gegenüber verantwortlich war. In dieser Eigenschaft bin ich damals täglich mit A. A. Kanthack zusammen thätig gewesen und bestätige ich hierdurch, dass sich Alf. A. Kanthack durch sein umfassendes Wissen, eiserne Energie, unermüdlichen Fleiss, durch seine grosse Wahrheitsliebe und strenge Selbstkritik und durch seine feinen, liebenswürdigen und gewinnenden Umgangsformen die Achtung und Liebe aller, die mit ihm in Berührung kamen, gewonnen und dauernd erhalten hat."

Kanthack had published a considerable number of valuable scientific communications, a few of the more important of which were, perhaps, the researches referred to concerning the larynx, his studies upon snake poison,* his various communications with relation to leucocytosis, chemotaxis and immunity,† his studies on mycetoma,‡ his Jackson Prize Essay on the bacillus of tetanus, and his further contributions to the same subject with Dr. Connell,§ and his admirable article upon the general pathology of infection in the first volume of Clifford Allbutt's System of Medicine. He also published in 1894, in association with Dr. Rolleston, a "Manual of Practical Morbid Anatomy, being a handbook for the post-mortem room," and in 1895 with Dr. Drysdale, a "Course of Elementary Practical Bacteriology, including Bacteriological Analysis and Chemistry."

He superintended the observations upon the Tsetse fly disease for the Royal Society, and one of his last publications related to this subject.‖

Much of his work, however, through his modesty and generosity, remained unknown. Only his more intimate friends are aware of the fact that he was the first to succeed in cultivating the parasite of actinomycosis. Compelled in January, 1890, to leave Berlin in the midst of his experiments, he made all possible arrangements for the preservation of his cultures, but on his return, they had, unfortunately, "died out" and another observer had anticipated him with the discovery.

A large share of his energy was given to the help and instruction of others who will bear the warmest testimony to the true worth of their friend and teacher.

His uncompromising honesty, his hatred of anything superficial or incomplete, combined with an active, keen, discriminating mind, and it seemed, an almost unlimited power for work, were a source of admiration to all who knew him. His amazing energy and capability for work were, however, too much even for a fine athletic physique, and his friends had for some years before his death looked with anxiety upon the amount of labor which he crowded into the day.

To the writer Kanthack always seemed the most brilliant of

---

*Beiträge zu der Histologie der Stimmbänder mit specieller Berücksichtigung des Vorkommens von Drüsen und Papillen. Arch. f. path. Anat., etc., Berl., 1889, cxvii, 531-544; Studien über die Histologie der Larynxschleimhaut—I. Die Schleimhaut des halbausgetragenen Foetus. Ibid., 1889, cxviii, 137-147; Zur Histologie der Stimmbänder: Erwiderung auf den vorstehenden Artikel des Herrn Prof. B. Fraenkel. Ibid., 376-381; Studien über die Histologie der Larynxschleimhaut. Ibid., 1890, cxix, 326; cxx, 273.

*The Nature of Cobra Poison. Journ. Physiol., Camb., 1892, xiii, 272-299. Report on Snake Venom in its Prophylactic Relations with Poisons of the Same and of Other Sorts. Rep. Med. Off. Local Gov., Bd. (1895-6), Lond., 1897, 235-266.

† Acute Leucocytosis Produced by Bacterial Products. Brit. Med. Journ., Lond., 1892, i, 1301-1303; Immunity, Phagocytosis and Chemotaxis. Brit. Med. Journ., Lond., 1892, ii, 985-989; (with Hardy) On the Characters and Behaviour of the Wandering (migrating) Cells of the Frog, especially in Relation to Micro-organisms. Proc. Roy. Soc. Lond., 1892, lii, 267-273, and Phil. Tr., Lond., 1895, clxxxviii, 279-318; (with Wesbrook) Report on Immunity Against Cholera: An experimental inquiry into the bearing on immunity of intracellular and metabolic bacterial products. Brit. Med. Journ., Lond., 1893, ii, 572-575; (with Hardy) The Morphology and Distribution of the Wandering Cells of Mammalia. Journ. Physiol., Camb., 1894, xvii, 81-119.

‡ Madura Disease (mycetoma) and Actinomycosis. Journ. Path. and Bact., Edinb. and Lond., 1892, i, 140-162.

§ The Flagella of the Tetanus Bacillus and Other Contributions to the Morphology of the Tetanus Bacillus. Journ. Path. and Bact., Edinb. and Lond., 1896-7, iv, 452, and Trans. Path. Soc. Lond., 1896-'97, xlviii, 271-279.

‖ Kanthack, A. A., H. E. Durham and W. F. H. Blandford: On Nagana or Tsetse Fly Disease. Proc. Roy. Soc., Vol. 64.

his contemporaries. His ideals were the highest; and never was a man truer to his ideals. An exacting and searching critic of his friends, he was a severer critic of himself. This amounted sometimes to self-depreciation; it was indeed, on such occasions, almost pathetic to note the apparent unconsciousness of his own superiority.

And with his high ideals he was ever full of practical suggestion. He never tired of urging the necessity of a more general introduction of accurate and scientific methods into medicine. His last public address* was an earnest appeal for more systematic and thorough clinical study in hospitals and schools.

His influence which was beginning to be generally felt in his own country was destined to have a far wider sphere. The loss of such a man is hardly greater to his university and to his friends than to the world at large.

Personally, Kanthack was the simplest and most lovable of men.

In 1895 he married Lucie, the daughter of F. Henstock, Esq., of Liverpool. W. S. T.

NOTES ON NEW BOOKS.

Operative Gynaecology. By HOWARD A. KELLY, A. B., M. D.; Professor of Gynaecology and Obstetrics in Johns Hopkins University, Baltimore; Gynaecologist and Obstetrician to Johns Hopkins Hospital, Baltimore. 2 vols., 550 pages each, with 48 plates and 592 original illustrations. (*D. Appleton, New York*, 1898.)

This work is practically a series of clinical lectures, thoroughly and exquisitely illustrated by drawings from cases which have been under the author's care.

Volume No. I contains nineteen lectures upon the following topics:

1. Sepsis, asepsis, and antisepsis in hospitals.
2. Antisepsis and asepsis in private practice.
3. Bacteriology.
4. Topographical anatomy.
5. The gynaecological examination.
6. Gynaecological instruments and dressings.
7. Anaesthesia.
8. General principles involved in plastic operations.
9. Diseases of the external genitals.
10. Rupture of the recto-vaginal septum and relaxed vaginal outlet.
11. Operations on the vagina.
12. Affections of the urethra and bladder.
13. Affections of the ureters.
14. Operations upon the cervix of the uterus, including dilatation and curettage.
15. Prolapse of the uterus.
16. Vaginal hysterectomy.
17. Inversion of the uterus.
18. Vaginal extirpation of the submucous myomata and polypi.
19. The uterus as a retention cyst.

The contents of Volume II are:

20. General principles and complications common to abdominal operations.
21. Care of wound and patient up to recovery.
22. Complications arising after abdominal operations.
23. Tubercular peritonitis.
24. Suspension of the uterus.
25. Conservative operations on the tubes and ovaries.
26. Simple salpingo-oöphorectomy and salpingo-oöphorectomy for adherent tubes and ovaries.
27. Vaginal drainage and enucleation for pyosalpinx, ovarian abscess, tubo-ovarian abscess, and pelvic abscess.
28. Hysterectomy, with extirpation of ovaries and tubes, abdominal hystero-salpingo-oöphorectomy.
29. Ovariotomy.
30. Abdominal hysterectomy for carcinoma and sarcoma of the uterus.
31. Myomectomy—hystero-myomectomy.
32. Operations during pregnancy.
33. Cesarean section.
34. Extra-uterine pregnancy.
35. The radical cure of hernia.
36. Intestinal complications.
37. The more remote results of abdominal operations.
38. On the conduct of autopsies, the making of protocols, and the preservation of tissues for microscopic examination in gynaecological practice.

Those who have been fortunate enough to see Dr. Kelly at home, will, while reading the work, easily imagine themselves in his operating room, listening to a brief history of the case to be operated upon; a review of the anatomy of the parts; a description of the operation to be done; the reasons for selecting this special procedure; the difficulties and dangers to be met, and the best way to overcome them. The style throughout is conversational, clear, concise, clean-cut, and impresses one with the feeling that the writer is presenting a frank statement of his experience in the treatment of the different diseased conditions met with in abdominal surgery.

Few books have been more eagerly looked for; few have so fully realized our expectations. The author in the opening paragraph of his preface says: "My aim in writing this book has been to place in the hands of many friends who have from time to time visited me, and followed my work, a convenient summary of the various gynaecological operations I have found best in my own practice. It is far from my purpose to present a digest of the literature of the subject, or even to describe all the important operations." The claims to originality are mainly connected with the operation for suspension of the uterus, the investigation of vesical and ureteral diseases, and with Kelly's modification of abdominal hysterectomy for fibroids. The chapters on sepsis and antisepsis, bacteriology, the conduct of autopsies, and preservation of tissues for microscopical examination, have been written with the assistance of acknowledged authorities in these several departments, and are deserving of more attention than is commonly given to chapters devoted to these subjects in surgical text-books.

However much we may desire to give special attention to individual chapters, the space at our disposal would preclude this, and we are compelled to speak of the work as a whole, and to present our impressions of it in a few sentences.

At first sight many will be inclined to think that the illustrations are the feature of the work, but those who have had any experience in abdominal surgery and its difficulties, and have read any considerable portion of the work carefully, will feel, that while the illustrations are all that illustrations could be, both from an artistic standpoint and because of their value in assisting the reader to follow the text, the great feature of the work is the careful selection of the best-known treatment for each disease described. Where, as in uterine fibroids, extra-uterine pregnancy, and pelvic abscess, the conditions in the different cases vary, the procedure best suited to those different conditions is indicated and clearly described. Wherever medical treatment is deemed of use, it is care-

* The Science and Art of Medicine. The Mid-sessional Address delivered before the Abernethian Society on July 7, 1898. St. Bartholomew's Hospital Journal, August, 1898.

fully outlined. The old-time "applications," however, find no place in the work. Where no mention is made of medical treatment it is because nothing can be hoped for from this quarter, and no course of treatment is encouraged which is likely to end in disappointment.

Another feature, and a pleasing one, is the spirit of conservatism which everywhere pervades the book. We find, for example, that par-ovarian cysts are now enucleated without sacrifice of the ovary, contrary to the former practice. In ovarian disease, where the tube is not involved, it is allowed to remain, and in uterine fibroids, when consistent with safety, myomectomy, and not hysterectomy is advised. While the work is of great value to all interested in abdominal surgery, representing, as it does, the most advanced thought of the day, it ought to receive special welcome from those practitioners who live at some distance from hospital centres. Such men, if they study the principles of aseptic abdominal surgery as enunciated in the early chapters of the work, will not only be enabled to retain under their own care cases now referred to the city specialist, but will also be able to extend treatment which, in the past, has only been possible in the larger centres, to those who on account of their limited means cannot avail themselves of the services of a specialist.

Dr. Kelly's original work on suspension of the uterus and affections of the bladder and ureters, places the profession under permanent obligation to him. In originating the operation of suspension of the uterus he has added materially to our resources in the treatment of certain uterine displacements (decensus and retro-displacements). With this operation we have had some little experience, having done upwards of seventy cases with a single relapse, and without mortality. Two patients subsequently became pregnant and were delivered at term of living children, without special discomfort or complication; two others are advanced four months in pregnancy, without development of any abnormal position of the uterus. If we restrict the operation of ventral fixation to those suffering from displacement and who have passed the menopause, and employ suspension in such as are liable to become pregnant, the operation is likely to increase in favor, as a safe and reasonably certain method of securing relief from local discomforts, as well as from disorders referred to the stomach, spine and legs. Certainly in no class of cases have we met with greater gratitude, or seen more marked improvement in general health, than in those selected for this operation.

The easy use of the cystoscope and ureteral catheter requires a little experience and manipulative skill. To those who possess these requisites, Kelly's cystoscope and ureteral catheter will prove invaluable instruments, enabling them to recognize and relieve distressing conditions not generally diagnosed and therefore not corrected by the ordinary practitioner. Those who have mastered the use of these instruments, and this with a little perseverance is easily possible to all, will not long remain in doubt as to their value.

The work is an embodiment of modern ideas clearly and concisely presented in good order, and well represents the most advanced operative gynaecology of the day.

LESSLIE M. SWEETNAM.

BOOKS RECEIVED.

Atlas of Legal Medicine. By Dr. E. von Hofmann. Authorized translation from the German. Edited by F. Peterson, M. D., assisted by A. O. J. Kelley, M. D. 1898. 12mo. (Saunders' Medical Hand-Atlases.) W. B. Saunders, Philadelphia.

Index Catalogue of the Library of the Surgeon-General's Office, United States Army. Authors and Subjects. Second Series, Vol. III. C—Czygan. 1898. 4to. 1100 pages. Government Printing Office, Washington, D. C.

A Pocket Medical Dictionary giving the Pronunciation and Definition of the Principal Words Used in Medicine and the Collateral Sciences, etc. By George M. Gould, A. M., M. D. A new edition entirely rewritten and enlarged, including over 21,000 words. 1898. 16mo. 530 pages. P. Blakiston's Son & Co., Philadelphia.

Twentieth Century Practice. An International Encyclopedia of Modern Medical Science by Leading Authorities of Europe and America. Edited by Thomas L. Stedman, M. D. In Twenty Volumes. Vol. XVII. Infectious Diseases and Malignant New Growths. 1898. 8vo. 715 pages. Wm. Wood & Co., New York.

Archives of Neurology and Psychopathology. Vol. I., Nos. 1-2, 1898. 8vo. 262 pages. State Hospital Press, Utica, N. Y.

Diseases of the Eye. A Handbook of Ophthalmic Practice for Students and Practitioners. By G. E. de Schweinitz, A. M., M. D. Third Edition. 1899. 8vo. 696 pages. W. B. Saunders, Philadelphia.

A Manual of Physiology. With Practical Exercises. By G. N. Stewart, M. A., D. Sc., M. D., Edin., D. P. H., Camb. Third Edition. 1898. 8vo. 848 pages. W. B. Saunders, Philadelphia.

A Text-Book of Mechano-Therapy. (Massage and Medical Gymnastics.) Especially Prepared for the Use of Medical Students and Trained Nurses. By A. V. Grafstrom, B. Sc., M. D. 12mo. 1899. 139 pages. W. B. Saunders, Philadelphia.

Saunders' Pocket Medical Formulary. By Wm. M. Powell, M. D. Fifth Edition. 1899. 16mo. 290 pages. W. B. Saunders, Phila.

The Treatment of Disease by Physical Methods. By Thomas Stretch Dowse, M. D., Abd., F. R. C. P., Ed. 1898. 8vo. 412 pages. John Wright & Co., Bristol.

A Text-Book of Obstetrics. By Barton Cooke Hirst, M. D. 1898. 8vo. 846 pages. W. B. Saunders, Philadelphia.

Purity and Truth. Self and Sex Series. What a Young Man Ought to Know. 1897. 16mo. 281 pages. The Vir Publishing Co., Phila.

Translation of Lectures Delivered by Aurelio Bianchi, M. D., Parma. On the Phonendoscope and its Practical Application. With Translation of Special Articles by F. Regnault, M. D. and M. Anastasiades, M. D. Translated by A. G. Baker, A. M., M. D. 1898. 8vo. 77 pages. G. P. Pilling & Son, Philadelphia.

Cleft Palate; Treatment of Simple Fractures by Operation; Diseases of Joints, etc. By W. Arbuthnot Lane, M. S. 1897. 12mo. 278 pages. The Medical Publishing Co., Limited, London.

Transactions of the American Gynecological Society. Vol. XXIII. 1898. 8vo. 491 pages. Wm. J. Dornan, Philadelphia.

THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains announcements of courses of lectures, programmes of clinical and pathological study, details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

Volume X is now in progress.

The subscription price is $1.00 per year.

The set of ten volumes will be sold for $20.00.